

DRAFT
2001 Progress Report

Occurrence, Distribution, Relative Abundance, and Habitat Relationships
of Amphibians and Reptiles
in Bighorn Canyon National Recreation Area



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The National Park Service, Greater Yellowstone Network,
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Executive Summary

Preliminary surveys of amphibians and reptiles in Bighorn Canyon National Recreation Area were conducted during the summer of 2001 in four weeks of sampling occurring from mid-May to early August. To ensure that we maximized our chances of detecting the occurrence of all species, we employed a variety of sampling techniques. Visual encounter surveys were the primary method used, with a total of 34 areas (18 terrestrial and 15 wetland habitats) searched using this technique. This method was supplemented with road driving, terrestrial funnel trapping, and calling surveys. A total of 206 observations were recorded-114 amphibians and 92 reptiles.

The occurrences of eight of the 16 species known to occur in Bighorn Canyon were confirmed by our surveys. Three of the eight species were amphibians and consisted of Woodhouse's Toads (*Bufo woodhousii*), Boreal Chorus Frogs (*Pseudacris maculata*), and Northern Leopard Frogs (*Rana pipiens*). The five reptiles found were Pigmy Short-horned Lizards (*Phrynosoma douglasii*), Common Sagebrush Lizards (*Sceloporus graciosus*), Gopher Snakes (*Pituophis catenifer*), Terrestrial Garter Snakes (*Thamnophis elegans*), and Western Rattlesnakes (*Crotalus viridis*).

The species detected during our surveys ranged in distribution from limited to widespread, and their relative abundance ranged from uncommon to abundant. Amphibian species that have undergone significant declines in parts of Wyoming and Montana, such as Woodhouse's Toads and Northern Leopard Frogs were found to occur in Bighorn Canyon. Woodhouse's Toads were encountered at the highest number of wetland sites and were common at those sites. Boreal Chorus Frogs and Northern Leopard Frogs were uncommon to common at wetland sites. Pigmy Short-horned Lizards were uncommon and only detected through contributed observations. The Common Sagebrush Lizard was the most frequently encountered species and was widely distributed and abundant. We found Gopher Snakes, Terrestrial Garter Snakes, and Western Rattlesnakes to be uncommon to common, depending on the type of habitat. The reptile species detected were found in various types of habitat. Common Sagebrush Lizards were most commonly found in juniper/mountain mahogany or disturbed/barren habitats. Gopher Snakes and Terrestrial Garter Snakes were primarily found in riparian or disturbed/barren habitats, while Western Rattlesnakes were detected most often in desert shrubland or disturbed/barren habitats.

Future work will include implementing a stratified, random sampling design in the summer of 2002 to further assess the occurrence, distribution, abundance and species-habitat associations of amphibians and reptiles in Bighorn Canyon.

Introduction

Preliminary surveys of reptiles and amphibians in Bighorn Canyon National Recreation Area (referred to herein as ‘Bighorn Canyon’) were conducted during the summer of 2001 in four weeks of sampling occurring from mid-May to early August. These initial surveys allowed us to become familiar with Bighorn Canyon, to gather data concerning the occurrence of amphibians and reptiles, and to obtain information necessary to design a stratified, random sampling scheme for surveys to be implemented in 2002. The primary goals of this two-year study are to inventory $\geq 90\%$ of the herpetofaunal species known to occur in the area, and gather additional data regarding the distribution, relative abundance, and habitat relationships of these species to assist in their management and future monitoring.

While amphibians and reptiles are traditionally overlooked in management programs, they are important for several reasons. They are important biologically because they serve as functional components of ecosystems and elements of biodiversity in many areas, and they serve as bio-indicators of the health of many ecosystems. In addition to their economic value (such as pest control and use in biomedical applications), these animals possess an aesthetic value that is appreciated by an ever-increasing portion of the public (Koch and Peterson 1995).

Evidence of recent global declines of some species of amphibians and reptiles has been described by recent studies (Rakestraw 1996, Youth 1997, Gibbons et al. 2000). In the Rocky Mountain Region, some formerly widespread, common species such as the Western Toad (*Bufo boreas*), Northern Leopard Frog (*Rana pipiens*), and the Common Garter Snake (*Thamnophis elegans*) have undergone declines (Corn and Fogelman 1984, Peterson et. al. 1992). These data indicate that we can no longer take the existence of these animals for granted, and that studies are needed to determine their status. As the primary mission of the National Park Service (NPS) “is to conserve unimpaired the natural and cultural resources and values of the national park system for the enjoyment of this and future generations,” scientific information about the condition of these natural resources must be obtained.

While many areas lack baseline data regarding the occurrence and distribution of amphibian and reptile species necessary to evaluate status and population trends, Bighorn Canyon is fortunate that an extensive survey of amphibians and reptiles was conducted prior to our surveys. Therefore, an unusual opportunity to assess changes in the status of amphibian and reptile species in this area exists. Prior to this study, two amphibian and reptile inventories were conducted in Bighorn Canyon. The University of Wyoming Cooperative Fishery and Wildlife Research Unit conducted the first extensive inventory of the recreation area in 1985 to gather

baseline data of species occurrence and distribution. The study also described the habitat associations of species along with their abundance relative to the habitats in which they were found (Redder 1986, Anderson et al. 1987). In 1998, the Montana Department of Fish, Wildlife and Parks Non-game Program conducted a limited survey on selected Bureau of Reclamation Impoundments in Montana, which included the Yellowtail Reservoir (Rauscher 1998). Despite these previous studies, further searching for unconfirmed species and additional information on reptile and amphibian occurrence and distribution is needed to better determine status changes in these animals over the past 15 years, as well as to assist in management by developing future monitoring protocol.

Objectives

The specific objectives of this study were:

1. To inventory and document $\geq 90\%$ of all amphibian and reptile species known to occur in Bighorn Canyon.
2. To design and implement stratified, random sampling surveys in the summer of 2002 to assess occurrence, distribution, relative abundance, and species-habitat associations of amphibians and reptiles in Bighorn Canyon.
3. To generate maps predicting the distribution of each species based on a topographic map, a cover type map, and species-habitat associations from survey data.
5. To compare our survey results with previous inventory work conducted in Bighorn Canyon to assess potential changes in amphibian and reptile status.
6. To develop recommendations for monitoring amphibians and reptiles in Bighorn Canyon based on repeated sampling at specific locations, to assess changes in species occurrence and distribution over time.

Study Area

Bighorn Canyon is a unique and highly diverse area because of the wide diversity of habitats that result from its geographical location. It lies in the rain shadow of the Absoroka-Beartooth Mountains of western Wyoming and Montana, between the Bighorn Mountains to the east and the Pryor Mountains to the west. Bighorn Canyon extends 90 km from north to south and is located approximately 12 km northeast of Lovell, Wyoming, and 40 km southeast of Billings, Montana (Figure 1).

The landscape encompasses 48,500 ha and consists of wide, flat valleys at the north and south ends with the central portion comprised of a rolling plain cut by the 335-m deep Bighorn

Canyon. High spatial variability in the climate exists due to wide geographic variation in temperatures and precipitation (Anderson et al. 1987). Yearly variability in temperature ranges from -39° C (-39° F) to 40.5° C (105° F) (Anderson et al 1987). According to 30-year climate data (1961-1990) recorded at a weather station in Lovell, Wyoming by the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) National Water and Climate Center, the highest average monthly temperature of 31.5° C (88.7° F) occurs in July. Elevation ranges from 1,120 m above sea level at the northernmost extent of the canyon near Fort Smith, Montana, to 2,355 m along the western extent of the recreation area in the Pryor Mountains, Wyoming. Because it lies in a rain shadow, a precipitation gradient exists between the southern and northern portions of the recreation area, causing variability in plant communities between the northern and southern portions of the recreation area. The southern end consists of desert receiving only 18 cm of precipitation per year, while the northern end consists of grassland receiving over 50 cm of precipitation per year (Anderson et al. 1987). Lovell, Wyoming receives an average of 17 cm of precipitation per year, with the lowest average precipitation (1.6 cm) during the summer months occurring in July (U.S. Department of Agriculture, National Water and Climate Center).

Plant communities in the south consist primarily of saltbush (*Atriplex* spp.) and greasewood (*Sarcobatus* spp.) in drier sites, with juniper (*Juniperus* spp.), sagebrush (*Artemisia* spp.), mountain mahogany (*Cercocarpus ledifolius*), and grasslands in the upland areas, and plains cottonwood (*Populus deltoides*) along the Bighorn River (Anderson et al. 1987). The central portion of the Bighorn Canyon consists primarily of upland areas with juniper, sagebrush, mountain mahogany, and grasslands. However, Douglas fir (*Pseudotsuga menziesii*) dominates the upper-most portions of the Pryor Mountains, with limber pine (*Pinus flexilis*) occurring on the lower benches. Several small creeks drain eastward from the Pryor Mountains and consist primarily of woody vegetation, such as narrowleaf cottonwood (*Populus angustifolia*), skunkbush (*Rhus trilobata*) (Anderson et al. 1987). In the north, the high plateaus are dominated by mixed grasslands inter-mixed with ponderosa pine (*Pinus ponderosa*) and Douglas fir occurring on north-facing slopes and mountain mahogany on south-facing slopes.

Methodology

Prior to our surveys, we compiled a list of species that have been documented to occur in Bighorn Canyon (Table 1) from the following sources: previous surveys (Redder, 1986; Rauscher 1998); existing databases (Wyoming and Montana Natural Heritage Program

Databases, Wyoming Biological Diversity Information Node); opportunistic observations (personal communication with park personnel); and the relevant literature (Baxter and Stone 1985, Stebbins 1985, Redder 1986, Anderson et al. 1987, Reichel and Flath 1995).

Prior to conducting surveys, we considered two broad categories of habitats to sample: (1) aquatic, wetland, and riparian sites, and (2) upland or terrestrial sites. Because all of the potential amphibian species breed in lentic habitats, we focused our amphibian sampling efforts in those habitats. Some reptiles are often found in both upland and riparian habitats, therefore our sampling for species such as the Terrestrial Garter Snake (*Thamnophis elegans*) and the Gopher Snake (*Pituophis catenifer*) will occur in both habitats. For the 2001 surveys, we restricted our sampling to areas where previous observations had been recorded during the 1985 surveys conducted by Redder (1986). We felt this was the best way to become familiar with the area and maximize our chance of detecting $\geq 90\%$ of the species known to occur there. Our sampling was also restricted to areas in the south and central portions of Bighorn Canyon because most of the observations made during the previous survey were in this general area. Also, because the south and central portions are separated from the northern-most portion (~3 mi. north of Barry's Landing to the Yellowtail Reservoir) by the Crow Indian Reservation and no roads directly connect them (Figure 1), we felt that for our initial surveys it would be logistically easier to survey only the south and central areas. However, for our 2002 surveys, we will sample throughout Bighorn Canyon by implementing a stratified, random sampling scheme designed using Geographic Information Systems (GIS). For more details on our 2002 surveying design, refer to the Future Work section.

Because no single technique is effective in detecting all species occurring in an area (Heyer et al. 1994, Olson et al. 1997), and to ensure that we maximized our chances of detecting all species, we employed a variety of sampling techniques (Table 2). Visual encounter surveys were the primary method used to detect the presence of amphibian and reptile species in Bighorn Canyon. A total of 34 areas, 18 upland (Figure 3a) and 15 wetland habitats (Figure 3b) were searched during visual encounter surveys. These surveys were also supplemented with road cruising, terrestrial funnel traps, and calling surveys. The specific survey techniques were performed as follows:

Visual Encounter Surveys (Jones 1986, Crump and Scott 1994)

The most suitable technique available for sampling amphibians and reptiles was visual encounter surveys. Visual encounter surveys consisted of observers walking through these areas and recording observations of any species encountered. Geographic coordinates for species

observations were determined with a Garmin eTrex Venture GPS (Garmin International Inc., Olathe, KS) unit. These GPS observation points were recorded with an accuracy of +/- 10 meters in UTM Zone 12N, North American Datum 1927 (NAD27).

A total of 34 visual encounter surveys were conducted in wetland habitats. Surveys were conducted two times at 14 sites and three times at two sites (Kane Cemetery Pond and Railroad Pond). During these surveys, geographic coordinates were determined with a GPS unit for each location where amphibians were located. Additional information taken at those locations was recorded onto a standardized data form (Figure 4) and included environmental data (air/water temperature, pH and water conductivity, cloud cover, and wind) and wetland site descriptions. Sites were visited once from May 21-31 to determine if breeding activity had begun and a second time from July 16-18 to assess breeding activity. These surveys (during which periodic samples are taken with dip nets) are very effective at detecting the larvae of frogs, toads, and salamanders (Crisafulli 1997). We used a fine-mesh dip net, and dipped every 5-7 steps around the perimeter of the wetland, as well as portions of the wetland that could be waded through. We also listened for calling amphibians.

Visual encounter surveys of upland terrestrial sites involved observers walking through sampling areas (e.g., along cliff faces, in washes, or 100 m transects in shrublands and grasslands) and turning cover objects, such as rocks and logs, to expose hiding animals. We conducted surveys in 18 terrestrial sampling areas (Figure 3a) where previous observations had been recorded during the 1985 surveys (Redder 1986). During these searches, we collected GPS waypoints to determine the general area searched along with the habitat types searched, the time spent searching each habitat, and the species observed. The habitat types assigned to our search areas were adapted from habitat classifications determined by Knight et al. (1987). Localities for all species observations were recorded with a GPS unit, and additional notes on environmental conditions (air temperature, cloud cover, and wind), and animal activity were taken at each locality.

Aquatic Funnel Trapping (Adams et al. 1997)

This technique was not used for the 2001 surveys, but will be incorporated into our sampling methods for the 2002 surveys. Aquatic funnel traps will consist of standard minnow traps that have a holding chamber with two tapered openings that direct organisms toward the trap interior. This has proven to be an effective method of capture, especially for larvae (Adams et al. 1997). Traps will be placed at designated areas with at least 10 cm of standing water, but not totally submerged. Trapping will be conducted for at least two nights for each designated area with a

maximum of ten traps placed at randomly selected sites within a wetland.

Terrestrial Funnel Trapping (Jones 1986, Beck 1997)

We experimented with supplementing terrestrial visual encounter surveys with individual terrestrial funnel traps. A total of 15 traps, three individual traps at five different locations, were installed on August 9 and run until August 13 (Figure 5). Traps consisted of a cylindrical holding chamber (60 cm. X 20 cm.) made of hardware cloth with two tapered openings that direct organisms toward the interior of the trap. Traps were placed along natural features such as bases of cliffs, rocks, and logs. Each trap was partially buried and covered with cardboard to protect any trapped animals from thermal extremes. Traps were checked every other day. This technique will be coupled with visual encounter surveys and will account for approximately 30% of our sampling effort for our 2002 surveys.

Calling Surveys (Rand and Drewery 1994, Zimmerman 1994)

Calling surveys were used to determine the presence of calling male anurans at wetland sites (Figure 2). Surveys consisted of stopping at sites and listening for chorusing frogs for a ten-minute period. The starting time for calling surveys varied throughout the summer depending on the time of sundown, but usually started no later than 30 minutes after sundown. Environmental conditions (cloud cover, moonlight, wind, and air temperature) were noted at each site. The species and numbers of calling anurans were noted using the Wisconsin method: category 1, a single male calling sporadically; category 2, a group of males calling with notable spaces between the calls; and category 3, a group of males calling with no distinction between individuals. We conducted calling surveys at 10 wetland sites to identify amphibian species that provide audible calls. We also listened for calling anurans during the visual encounter surveys at the wetland sites.

An Automated Recording System was also used in conjunction with calling surveys to detect the presence of calling anurans. This method utilized an automated recording system (Frog Logger) that records sound at specified intervals (Peterson and Dorcas 1994). We used the information recorded as a reference to determine known sites where amphibians are present and calling and to provide us with information about when calling begins so we can perform calling surveys during the height of the breeding season. We placed Frog Loggers once at three sites and twice at another to determine if the nights we performed calling surveys were typical nights of calling, and that we did not sample on evenings when amphibians were not calling at reference areas. This also helped ensure that we do not overlook the presence of rare species.

Road Surveys (Jones 1986, Shaffer and Jutterbock 1994)

Because some species are best found on roads following sunset, we performed road surveys via nighttime road driving (to the extent allowable by the limited roads within the park). When possible, we conducted road surveys on rainy as well as clear nights. Nighttime road surveys were conducted primarily on the main paved road of the recreation area (Highway 37) from the park entrance to Barry's Landing and back (Figure 2) by driving at low speeds (approximately 30 km/hour) between 1900 and 2400 hours. Road surveys were performed from April 27-28, May 21-31, and June 6-7. A total of 16 hours were spent conducting these surveys.

Results and Discussion

Our results are organized into the following sections: (1) sampling technique evaluation; (2) occurrence; (3) distribution; (4) abundance; (5) habitat associations; (6) species accounts. For a list of the species encountered and the number of individual species recorded by each survey method, refer to Table 3 and Figure 6. The species observed according to the day of the year can be found in Figure 7.

Sampling Technique Evaluation

A total of 206 observations were made during the 2001 preliminary surveys-114 of these were amphibians and 92 were reptiles. Of these observations, 141 of them were recorded during visual encounter surveys, 24 were recorded during calling surveys, 11 were made during road surveys, seven were opportunistic observations, four were terrestrial funnel trap captures, and 19 were contributed observations from park personnel. For the number of each species recorded by each survey technique, refer to Figure 6.

The effectiveness of the sampling techniques implemented during our surveys varied greatly. We evaluated each technique based on the number of observations recorded per hour, the relative cost of implementing the technique, and the length of time to conduct each technique. Visual encounter surveys were the most successful technique used to detect the presence of amphibians and reptiles. Because this technique is relatively inexpensive and time efficient, it was chosen as our primary technique. We spent a total of 69 hours conducting these surveys and gathered a total of 141 observations, resulting in about two observations per hour of searching.

Nighttime calling surveys were effective at detecting the presence of calling male anurans at sites where species were not detected using visual encounter surveys. Woodhouse's Toads (*Bufo woodhousii*) were detected at two sites and Boreal Chorus Frogs (*Pseudacris maculata*) were detected at 12 sites where they were not found by visual encounter surveys conducted at those sites. Calling surveys take relatively little time to perform and are very cost effective. Frogloggers were also used to detect the presence of calling male anurans. This technique only

accounted for one observation and as a result was not effective. However, it will be used during our 2002 surveys as a control by placing it at known calling sites to determine if the nights we performed calling surveys were typical nights of calling.

Road driving was not the most effective technique when comparing the number of observations recorded per hour with other techniques such as visual encounter surveys, but it was valuable for detecting certain species like Gopher Snakes (*Pituophis catenifer*). Seven of the nine Gopher Snake observations were recorded during road driving. Western Rattlesnakes and Terrestrial Garter Snakes were also observed while conducting these surveys. We spent a total of 16 hours driving roads and recorded a total of 11 observations, resulting in 0.69 observations for every hour of driving.

Because we experimented with using terrestrial funnel traps during our surveys, they were only used for a period of five days, yet recorded a total of four observations. This technique can be effective at locating species that are cryptic or nocturnally active. Terrestrial funnel traps require some time to install, but once they are installed, require relatively little time to check (every 2-3 days) and can capture species while other surveys are conducted. Therefore, this technique will be coupled with visual encounter surveys during our 2002 surveys.

Occurrence

A total of 16 amphibian and reptile species have been confirmed to occur in Bighorn Canyon National Recreation Area (Table 1). Of these 16 confirmed species, eight were found during our surveys. Three of the eight species were amphibians and consisted of Woodhouse's Toads (*Bufo woodhousii*), Chorus Frogs (*Pseudacris maculata*), and Northern Leopard Frogs (*Rana pipiens*). The five reptiles found were Pigmy Short-horned Lizards (*Phrynosoma douglasii*), Common Sagebrush Lizards (*Sceloporus graciosus*), Gopher Snakes (*Pituophis catenifer*), Terrestrial Garter Snakes (*Thamnophis elegans*), and Western Rattlesnakes (*Crotalus viridis*).

Of the amphibian species detected, they were found to occur at 10 of the 15 wetland sites surveyed (Table 4). Boreal Chorus Frogs and Northern Leopard Frogs occurred at all of the sites where Woodhouse's Toads were detected. However, Woodhouse's Toads occurred at only seven of nine (78%) of the Boreal Chorus Frog sites and six of nine (67%) of the Northern Leopard Frog sites. For more information on the co-occurrence of these species, refer to Table 5. Refer to Table 4, for a list of the wetland sites where species occurred.

Other amphibian and reptile species that have been confirmed to occur in Bighorn Canyon, but were not detected during our surveys consist of two amphibian species, Tiger Salamanders (*Ambystoma tigrinum*) and Plains Spadefoots (*Spea bombifrons*), and six species of reptiles,

Snapping Turtles (*Cheyltra serpentina*), Spiny Softshell Turtles (*Apolone spinifera*), Painted Turtles (*Chrysemys picta*), Rubber Boas (*Charina bottae*), Eastern Racers (*Coluber constrictor*), and Milk Snakes (*Lampropeltis triangulum*).

These species may not have been detected during our surveys for a few reasons. Tiger Salamander occurrence in Bighorn Canyon is rare and this species was only detected once during previous surveys (Redder 1986), therefore it is likely to only be detected through an opportunistic encounter. The Plains Spadefoot is an opportunistic breeder and is difficult to detect if surveys are not conducted while it is breeding. The three turtles known to occur in Bighorn Canyon commonly inhabit riverine areas and it is likely that we were unable to detect these species because we did not have a boat to sample in riverine habitat. However, during our 2002 surveys, we intend to conduct visual encounter surveys of riverine habitat using a boat. It is likely that Eastern Racers were not detected because they are not known to occur in the southern portion of Bighorn Canyon and we did not survey in the northern areas of the recreation area where the grasslands they inhabit are most common. We intend to sample in the northern areas of the park during our 2002 surveys. Rubber Boas and Milk Snakes, to our knowledge have only been detected through opportunistic encounters.

Distribution

Because the southern end of Bighorn Canyon National Recreation Area consists of a desert that receives only 18 cm of precipitation per year, the distribution of wetland habitat is limited (Figure 3b). The majority of the wetlands occur in the southern portion of Bighorn Canyon in the floodplain of the Bighorn River. As a result, the distribution of amphibians determined from our surveys is somewhat limited throughout the entire study area to the southern portion of Bighorn Canyon.

For reptiles, the majority of the species detected during our surveys were found to be limited in distribution (Table 2). The Common Sagebrush Lizard was the most frequently encountered species and is widespread throughout Bighorn Canyon. Gopher Snakes, Terrestrial Garter Snakes, and Western Rattlesnakes were limited in distribution. Pigmy Short-horned Lizards were only detected by contributed observations and are spotty in distribution.

Abundance

The overall abundance of amphibian species in Bighorn Canyon is uncommon due to the limited distribution of wetland habitat throughout the recreation area. However, within the wetland habitats surveyed, Woodhouse's Toads were encountered at the highest number of

wetland sites and are common at those sites. Boreal Chorus Frogs were also common and Northern Leopard Frogs were uncommon to common at wetland sites.

All but one of the reptile species found during our surveys were either uncommon or common in abundance throughout Bighorn Canyon (Table 2). Common Sagebrush Lizards were the only species found to be abundant in Bighorn Canyon. Gopher Snakes were uncommon to common. Terrestrial Garter Snakes and Western Rattlesnakes are common throughout the area. Pigmy Short-horned Lizards were uncommon.

Habitat Relationships

The amphibian and reptile species encountered during our surveys were found in three major habitat types (Figure 8). All amphibian species were found only in wetland habitats. Reptile species were most abundant in upland areas and were most frequently found in juniper/mountain mahogany habitats and disturbed/barren habitats. Some species, such as Terrestrial Garter Snakes, were also quite common in riparian habitats. Thirty of the 92 reptile observations were made in disturbed/barren habitat (33%), 25 observations were collected in juniper/mountain mahogany habitat (27%), and 12 observations were recorded in riparian habitat (13%).

Species Accounts

Woodhouse's Toad (*Bufo woodhousii*). This species was detected best by visual encounter surveys and was found at nine of the 15 sites surveyed (Figure 9). Its distribution within the wetland sites surveyed is the most widespread of any amphibian species detected, but due to the lack of wetland sites in Bighorn Canyon, its overall distribution is limited. This species was found at 60% of the wetland sites surveyed and accounted for 36% of all amphibian observations. Larvae and juveniles of this species were found during visual encounter surveys. Adults can be difficult to find because they often bury themselves in sandy substrates. Woodhouse's toads were found only in wetland habitat during our surveys (Figure 8), and were usually observed along muddy to dry silty shorelines and shallow, water areas with sparse emergent vegetation.

Boreal Chorus Frog (*Pseudacris maculata*). This species was not located using visual encounter surveys, but was detected by nighttime calling surveys. Chorus frogs were detected by calling surveys at eight of the 15 wetland sites (Figure 10) and constituted only 10% of all amphibian observations. This species can be difficult to detect with visual encounter surveys, due to its small size and cryptic color. However, based on calling survey results, this species has a widespread distribution among the wetland sites surveyed, but is limited throughout Bighorn Canyon. The relative abundance of this species is difficult to assess due to the lack of

observations recorded by visual encounter surveys, but based on the abundance of calling made by adult males during the breeding season, this species is common. This species was detected in wetland habitat (Figure 8) and was more common at wetlands with emergent vegetation, such as cattails, sedges, and grasses.

Northern Leopard Frog (*Rana pipiens*). This species is listed under special status by the Bureau of Land Management and the U.S. Forest Service. Visual encounter surveys were the best method used to detect this species. We observed them at 6 of the 15 sites (Figure 11). They made up 54% of all amphibian observations. Seven adults and 54 juveniles were detected during our surveys. This species was found to be limited in distribution throughout Bighorn Canyon and was uncommon to common at the wetland sites where it was detected. Leopard frogs were found only in wetland habitat (Figure 8), usually in shallow water in or near emergent vegetation such as cattails, sedges, and grasses.

Pigmy Short-horned Lizard (*Phrynosoma douglasii*). This lizard was only detected through contributed observations from park personnel and consisted of only 10% of the reptile sightings recorded. The only observations collected during our surveys were contributed from park personnel. They are uncommon in Bighorn Canyon. This species was spotty in distribution (Figure 12) and only found on the east slope of the Pryor Mountains. Because we were unable to detect this species during our surveys, we cannot assess its habitat associations, but it typically inhabits grasslands and open shrublands with loose, sandy substrates.

Common Sagebrush Lizard (*Sceloporus graciosus*). This species was found to be abundant throughout the areas surveyed in Bighorn Canyon. Visual encounter surveys were the most successful sampling technique at detecting this species. It was the most widely distributed reptile species, occurring at 20 sites and accounting for 51% of all reptile observations (Figures 13, 14a, 14b, 14c, 14d, and 14e). Common Sagebrush Lizards were found most frequently in juniper/mountain mahogany habitat or disturbed and barren habitat (Figure 8).

Gopher Snake (*Pituophis catenifer*). Road driving was the most successful sampling technique for detecting Gopher Snakes. This species was limited in distribution and was most commonly found on roads from late April through May in drier areas not far from riparian systems, such as the Crooked Creek area (Figures 15, 16a, 16b, and 16c). They are uncommon to common in Bighorn Canyon. Gopher Snakes were found in riparian habitats at Hillsboro and in barren, disturbed habitats (roads) near Crooked Creek and Railroad Pond (Figure 8).

Terrestrial Garter Snake (*Thamnophis elegans*). This species was detected best by visual encounter surveys. It was found at 11 sites and is limited throughout Bighorn Canyon (figure

17), but accounted for 43% of all snake species observed and 16% of all reptile sightings. This species is common. They were found in the Hillsboro, Crooked Creek, and Ewing-Snell ranch areas (Figures 18a, 18b, and 18c). It is common in both Wyoming and Montana. This species was found in riparian, wetland, and disturbed or barren habitats (Figure 8). It was observed near water, 11 of 15 times it was sighted, often along stream banks or near the edge of wetlands.

Western Rattlesnake (*Crotalus viridis*). This species was detected only once using visual encounter surveys, but was most successfully detected by road driving (three observations) and terrestrial funnel traps (two observations). Western Rattlesnakes were found to be limited in distribution (Figure 19) in Bighorn Canyon during our surveys. They were observed at 10 sites and accounted for 31% of all snake species observed and 12% of the reptiles observed (Figures 20a, 20b, 20c, and 20d). This species is common. It was found primarily in desert shrubland habitats and disturbed/barren habitats, but was also detected in riparian and juniper/mountain mahogany habitats (Figure 8). This species was found on the desert shrubland flats west and southwest of Sykes Mountain, near Horseshoe Bend and Barry's Landing, and at Layout Creek near the Ewing-Snell ranch.

Future Work

During the summer of 2002, a stratified, random sampling scheme will be implemented to further assess the occurrence, distribution, abundance, and species-habitat associations of reptiles and amphibians in Bighorn Canyon. The sampling design will utilize existing Digital Elevation Models (DEMs) and cover type maps. We will use ArcGIS 8, the Spatial Analyst and 3D Analyst modules (ESRI, Redmond, CA), and the Animal Movement extension (USGS) to develop a map of environmental types (or stratification units) based on topography and cover. The three topographic categories used will be based on aspect and slope: (1) flat (slope less than 5 degrees); (2) northeast (slope greater than 5 degrees and an aspect between 315 and 135 degrees); and (3) southwest (slope greater than 5 degrees and an aspect between 135 and 315 degrees). I will use 3D Analyst with the DEMs to create a triangular irregular network (TIN) representing the surface of the study area with polygons (triangles) of varying slope and aspect. A cover type map of habitat classifications will consist of nine categories adapted from Knight et al. (1987): (1) wetland; (2) riparian; (3) desert shrubland; (4) sagebrush steppe; (5) grassland; (6) juniper/mountain mahogany; (7) coniferous woodland; (8) disturbed; (9) barren. The categories from the cover type map will be combined to produce a map with collapsed categories of cover. The themes of the three topographic categories will be combined with the collapsed cover categories to produce themes for different environmental types (stratification categories). This

design will be used to select sites for terrestrial trapping and visual encounter surveys during the summer of 2002.

Other future work includes: (1) developing a map predicting distribution for each species based on modeling from the 2001 and 2002 survey results; (2) comparing our survey results with previous inventory work conducted in Bighorn Canyon and; (3) developing recommendations for monitoring protocols for Bighorn Canyon based on repeated sampling at specific locations in order to assess changes in species occurrence over time.

Acknowledgements

Financial support for this survey was provided by the National Park Service. We would like to thank Rick Lasco, the Bighorn Canyon National Recreation Area Resource Manager for logistical support, and his Resource Management crew for their assistance and contributed observations throughout the summer. We would especially like to thank Lane Cameron of Yellowstone National Park for his assistance. Park Ranger Wendy Bredow provided important logistical assistance and contributed observations. We would like to thank Kayla Grams and Julie Roser of the U.S. Geological Survey crew for contributing reptile observations. Also, we would like to thank Alan J. Redder for sharing information from his previous surveys of the area and for assisting us in the field.

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Tables

Table 1. A list of amphibians and reptile species potentially occurring in the Bighorn Canyon National Recreation Area with current heritage rank, federal status, statewide abundance, and distribution notes. Prepared from Stebbins 1985, Baxter and Stone 1985, Redder 1986, Anderson et al., 1987, and Reichel and Flath 1995. The current heritage ranking, federal status, statewide abundance, and range notes were compiled by the Wyoming Natural Diversity Database (Fertig and Beauvais, 1999), the Wyoming Bio-information Node, and the Nature Conservancy's Natural Heritage Program for Montana and Wyoming.

| Common Name | Scientific Name | Occurrence | Heritage Ranks* | Federal Status* | Statewide Abundance* |
|-----------------------------|--------------------------------|------------|-----------------|--------------------------|----------------------|
| Amphibians | | | | | |
| Tiger Salamander | <i>Ambystoma tigrinum</i> | confirmed | G5/S3S4 | USFS R2-S | common |
| Woodhouse's Toad** | <i>Bufo woodhousii</i> ** | confirmed | S5 | | common |
| Plains Spadefoot | <i>Spea bombifrons</i> | confirmed | S5 | | common |
| Boreal Chorus Frog** | <i>Pseudacris maculata</i> ** | confirmed | S5 | | common |
| Northern Leopard Frog** | <i>Rana pipiens</i> ** | confirmed | G5/S3 | USFS R2-S BLM-SS | common |
| Great Plains Toad | <i>Bufo cognatus</i> | possible | G5/S3 | | uncommon |
| Western Toad | <i>Bufo boreas</i> | possible | G4T1Q/S1 | USFS R2-S USFWS Cand. | common |
| Columbia Spotted Frog | <i>Rana luteiventris</i> | possible | G4/S2S3 | USFS R2-S BLM-SS | common |
| Reptiles | | | | | |
| Snapping Turtle | <i>Chelydra serpentina</i> | confirmed | G5/S3 | BLM-SS | common |
| Painted Turtle | <i>Chrysemys picta</i> | confirmed | S5 | | common |
| Spiny softshell | <i>Apolone spinifera</i> | confirmed | G5/S4 | BLM-SS | common |
| Pigmy Short-horned Lizard** | <i>Phrynosoma douglasii</i> ** | confirmed | S4 | | common |
| Common Sagebrush Lizard** | <i>Sceloporus graciosus</i> ** | confirmed | S5 | | common |
| Rubber Boa | <i>Charina bottae</i> | confirmed | G5/S2S3 | | rare |
| Eastern Racer | <i>Coluber constrictor</i> | confirmed | G5T5/S4 | | common |
| Milk snake | <i>Lampropeltis triangulum</i> | confirmed | G5/S2S3 | USFS R2-S | rare |
| Gopher snake** | <i>Pituophis catenifer</i> ** | confirmed | S4 | | common |
| Terrestrial Garter snake** | <i>Thamnophis elegans</i> ** | confirmed | S5 | | common |
| Western Rattlesnake** | <i>Crotalus viridis</i> ** | confirmed | S5 | | common |
| Plains Garter snake | <i>Thamnophis radix</i> | possible | G5T5/S4 | | common |
| Common Garter snake | <i>Thamnophis sirtalis</i> | possible | S5 | | common |

* A list of descriptions for the heritage rank codes, federal status codes, statewide abundance, and range notes are on the following page.

** Presence in Bighorn Canyon Nation Recreation Area confirmed during our 2001 surveys.

Descriptions for heritage ranks, federal status, statewide abundance, and range notes:

Heritage Ranks

Heritage ranks consist of a standardized ranking system developed by The Nature Conservancy's Natural Heritage Network to assess the global and statewide conservation status of each plant and animal species, subspecies, and variety. Each taxon is ranked on a scale of 1-5, from highest conservation concern to lowest. Codes are as follows:

- G** Global rank: Rank refers to the rangewide status of a species.
- T** Trinomial rank: Rank refers to the rangewide status of a subspecies or variety.
- S** State rank: Rank refers to the status of the taxon in Wyoming and Montana.
- 1** Critically imperiled because of extreme rarity (often known from 5 or fewer extant occurrences or very few remaining individuals) or because some factor of a species' life history makes it vulnerable to extinction.
- 2** Critically imperiled because of extreme rarity (often known from 5 or fewer extant occurrences or very few remaining individuals) or because some factor of a species' life history makes it vulnerable to extinction.
- 3** Rare or local throughout its range or found locally in a restricted range (usually known from 21-100 occurrences).
- 4** Apparently secure, although the species may be quite rare in parts of its range, especially at the periphery.
- 5** Demonstrably secure, although the species may be rare in parts of its range, especially at the periphery.

Federal Status

The following categories are now being used to rank listed and candidate species by the Bureau of Land Management (BLM), the U.S. Fish and Wildlife Service (USFWS) and the U.S. Forest Service (USFS):

BLM-SS: Bureau of Land Management Species of Special Status

USFWS Cand: U.S. Fish and Wildlife Service Candidate Species, taxa for which substantial biological information exists on file to support a proposal to list as Endangered or Threatened, but no proposal has yet been published in the Federal Register.

USFS R2-S: U.S. Forest Service Region 2, Sensitive Species

Range Notes

SE periphery: Wyoming occurrence of taxon is at the southeastern edge of its contiguous range.

W periphery: Wyoming occurrence of taxon is at the western edge of its contiguous range.

Core: Wyoming occurrence of taxon is at the core of its contiguous range.

Table 2. A checklist of the amphibians and reptiles confirmed to occur in Bighorn Canyon National Recreation Area during our 2001 surveys with notes on the distribution and relative abundance within the study area.

| Common Name | Scientific Name | Distribution* | Estimated Abundance* | Successful Sampling Techniques* | Voucher |
|---|-----------------------------|---|--|---|-----------------------------|
| <i>Amphibians</i> | | | | | |
| Woodhouse's Toad | <i>Bufo woodhousii</i> | limited | common | visual encounter surveys, calling surveys, froglogger | |
| Boreal Chorus Frog | <i>Pseudacris maculata</i> | limited | common | calling surveys | |
| Northern Leopard Frog | <i>Rana pipiens</i> | limited | uncommon/ common | calling surveys, visual encounter surveys | photograph |
| <i>Reptiles</i> | | | | | |
| Pigmy Short-horned Lizard | <i>Phrynosoma douglasii</i> | spotty | uncommon | contributed observations only | |
| Common Sagebrush Lizard | <i>Sceloporus graciosus</i> | widespread | abundant | visual encounter surveys | |
| Gopher snake | <i>Pituophis catenifer</i> | limited | uncommon/ common | road driving, visual encounter surveys, contributed | |
| Terrestrial Garter snake | <i>Thamnophis elegans</i> | limited | common | visual encounter surveys, opportunistic, contributed | |
| Western Rattlesnake | <i>Crotalus viridis</i> | limited | common | road driving, terrestrial funnel trapping, visual encounter surveys | |
| Classification Information: Names based on Integrated Taxonomic Information System (IT IS) website 2002 | | widespread limited spotty *based on our survey | abundant common uncommon rare *based on our survey | Techniques employed: calling surveys froglogger opportunistic road driving terrestrial funnel traps *listed in order of success in our surveys | museum specimen, photograph |

Table 3. The type and number of observations made during the 2001 surveys with the number of individuals of each species recorded

| Observation Type | # of Species Observed | Species Observed ¹ (# of individuals of each species observed) |
|---------------------------------|-----------------------|---|
| Opportunistic | 7 | SCGR (3), THEL (4) |
| Road driving* | 11 | CRVI (3), PICA (7), THEL (1) |
| Terrestrial funnel trap capture | 4 | CRVI (2), SCGR (2) |
| Visual encounter surveys | 141 | BUWO (31 juveniles, 1 larvae), CRVI (1), PICA (1), RAPI (58: 4 adults, 54 juveniles), SCGR (40), THEL (9) |
| Calling Surveys | 24 | BUWO (9), PSMA (12), RAPI (3) |
| Contributed observations | 19 | CRVI (5), PHDO (9), PICA (1), SCGR (3), THEL (1) |
| TOTAL: | 206 | BUWO (41), CRVI (11), PHDO (9), PICA (9), PSMA (12), RAPI (61), SCGR (48), THEL (15) |

* Seven out of the 12 observations recorded during road cruises were road fatalities.

¹Species codes:

BUWO – *Bufo woodhousii*

PSMA – *Pseudacris maculata*

RAPI – *Rana pipiens*

PHDO – *Phrynosoma douglassi*

SCGR – *Sceloporus graciosus*

PICA – *Pituophis catenifer*

THEL – *Thamnophis elegans*

CRVI – *Crotalus viridis*

Table 4. The wetland sites where amphibian species were detected using visual encounter surveys and calling surveys. (Refer to Figure 3b for site locations)

| Site | Chorus Frog | Northern Leopard Frog | Woodhouse's Toad |
|------------------------|-------------|-----------------------|------------------|
| 1. Pond 1* | | | |
| 2. Pond 2* | | | |
| 3. Pond 3* | | | |
| 4. Pond 4* | | | |
| 5. Pond 5 | X | X | X |
| 6. Pond 6 | | | X |
| 7. Pond 6 1/2 | X | X | X |
| 8. Pond 7 | X | X | X |
| 9. Pond 8 | X | X | X |
| 10. Pond 9 | X | X | X |
| 11. Pond 10** | | | |
| 12. Pond 11 | | | |
| 13. Classroom Pond | | | |
| 14. Kane Cemetery Pond | X | X | X |
| 15. Leck Mays Pond | X | | X |
| 16. Railroad Pond | X | | X |

* Sites were almost completely dry.

**This site was not surveyed because it was completely dry by mid-May.

Table 5. This table represents the probability of amphibian species co-occurrence based on results from visual encounter surveys and calling surveys. Numbers in parentheses in row headings indicate the total number of sites where that particular species occurred. Reading across the rows, the numbers in the individual cells of the matrix represent the probability of co-occurrence between the two species, based on the number of sites where the species in that column occurs.

| Species | Chorus Frog | Leopard Frog | Woodhouse's Toad |
|---------------------------------|--------------------|---------------------|-------------------------|
| Chorus Frog (7) | X | 0.71 (5/7) | 1.00 (7/7) |
| Leopard Frog (6) | 0.83 (5/6) | X | 1.00 (6/6) |
| Woodhouse's Toad (9) | 0.78 (7/9) | 0.67 (6/9) | X |

Table 6. Amphibian calling survey observations and frog logger calling data recorded during the Bighorn Canyon National Recreation Area 2001 surveys.

| Date | Time | Species | Observer(s) | Location | Comments | CC (%) | Wind | Air Temp |
|-----------|------|---------|-------------|----------------------------|---|--------|----------------|----------|
| 29-Apr-01 | 2127 | PSMA | Baum, R. | Pond 8 | cat. 1 | N/A | N/A | N/A |
| 29-Apr-01 | 2130 | PSMA | Baum, R. | Railroad Pond | cat. 1 | N/A | N/A | N/A |
| 21-May-01 | 2001 | PSMA | Baum, R. | Pond 6 1/2 | cat. 1 | 30 | light | 16 C |
| 21-May-01 | 2001 | PSMA | Baum, R. | Pond 7 | cat. 1 | 30 | light | 16 C |
| 21-May-01 | 2008 | RAPI | Baum, R. | Pond 7 | cat. 1 | 30 | light | 16 C |
| 21-May-01 | 2014 | PSMA | Baum, R. | Pond 8 | cat. 1 | 30 | light | 16 C |
| 21-May-01 | | 0 | Froglogger | Railroad Pond | none | N/A | N/A | N/A |
| 22-May-01 | 2200 | PSMA | Baum, R. | Pond 5 | cat. 1 | 5 | moderate | 18 C |
| 22-May-01 | 2205 | BUWO | Baum, R. | Pond 5 | cat. 1, north end | 5 | moderate | 18 C |
| 22-May-01 | 2234 | BUWO | Baum, R. | Kane Cemetery Pond | cat. 2 | 5 | moderate | 18 C |
| 22-May-01 | 2254 | 0 | Baum, R. | Pond 6 | none | 0 | light | 18 C |
| 22-May-01 | | BUWO | Froglogger | Kane Cemetery Pond | cat. 1 | N/A | N/A | N/A |
| 23-May-01 | 2110 | PSMA | Baum, R. | Pond 9 | cat. 3 | 10 | light-moderate | 21 C |
| 23-May-01 | 2115 | BUWO | Baum, R. | Pond 9 | cat. 1, north end | 10 | light-moderate | 21 C |
| 23-May-01 | 2117 | RAPI | Baum, R. | Pond 9 | cat. 1, northeast end | 10 | light-moderate | 21 C |
| 23-May-01 | 2127 | 0 | Baum, R. | Pond 10 | none | 10 | light | 21 C |
| 23-May-01 | 2147 | PSMA | Baum, R. | Pond 8 | cat. 2 | 15 | light | 21 C |
| 23-May-01 | 2157 | BUWO | Baum, R. | Pond 8 | cat. 2, southwest end | 15 | light | 21 C |
| 23-May-01 | 2159 | BUWO | Baum, R. | Pond 6 1/2 | cat. 1, north end | 15 | light | 21 C |
| 23-May-01 | 2201 | PSMA | Baum, R. | Pond 7 | cat. 1, northwest end | 15 | light | 21 C |
| 23-May-01 | 2209 | RAPI | Baum, R. | Pond 7 | cat. 1, north-northwest end | 15 | light | 21 C |
| 23-May-01 | 2211 | PSMA | Baum, R. | Railroad Pond | cat. 3 | 15 | light | 21 C |
| 23-May-01 | 2215 | BUWO | Baum, R. | Railroad Pond | cat. 2 | 15 | light | 21 C |
| 23-May-01 | | 0 | Froglogger | Pond 11 | none | N/A | N/A | N/A |
| 02-Jun-01 | | 0 | Froglogger | Hillsboro | placed next to wetland/riparian area above ranch | N/A | N/A | N/A |
| 07-Jun-01 | 2125 | 0 | Baum, R. | Classroom Pond | none | 40 | moderate | 22.2 C |
| 07-Jun-01 | 2159 | PSMA | Baum, R. | Leck Mays Pond | cat. 3 | 30 | moderate | 22.2 C |
| 07-Jun-01 | 2201 | BUWO | Baum, R. | Leck Mays Pond | cat. 2 | 30 | moderate | 22.2 C |
| 07-Jun-01 | 2215 | BUWO | Baum, R. | 14A Bridge over Bighorn R. | cat. 2, north side of bridge, west side of floodplain | 30 | moderate | 22.2 C |
| 07-Jun-01 | 2215 | PSMA | Baum, R. | 14A Bridge over Bighorn R. | cat. 3, north side of bridge, west side of floodplain | 30 | moderate | 22.2 C |
| 07-Jun-01 | | 0 | Froglogger | Kane Cemetery Pond | placed on south end of pond | N/A | N/A | N/A |

*See following page for abbreviation codes

Abbreviation Codes for Amphibian Calling Survey Table:

Species: BUWO - *Bufo woodhousii*
PSMA - *Pseudacris maculata*
RAPI – *Rana pipiens*

Time: Military time (24 hours)

Location: General description of the area where the observation was made

Comments: Additional comments about the observation locality and about the organism observed
cat. 1 (category 1): single male calling sporadically
cat. 2 (category 2): a group of males calling with notable spaces between the calls
cat. 3 (category 3): group of males calling with no distinction between individuals

CC: Cloud cover (estimated as a percentage)

Wind: Wind speed (estimated as calm, light, light-moderate, moderate, high)

Air Temp: Ambient temperature from a Schultheis thermometer, measured in degrees Celsius

Table 7. The habitat types searched in the Bighorn Canyon National Recreation Area with hectares and percentages of each habitat (from Knight et al., 1987) along with the number and species of amphibians and reptiles found in each habitat, and search time per habitat.

| Habitat Type | Area* | | # | Amphibians Species ¹ | Reptiles Species ¹ | # | Search Time | |
|------------------------------|----------|-------|---|------------------------------------|----------------------------------|---|-------------|-------|
| | Hectares | % | | | | | (hrs.) | % |
| Wetland | 293 | 1.3 | 3 | BUWO, PSMA, RAPI | THEL | 1 | 23.1 | 33.4 |
| Juniper/Mountain Mahogany | 8909 | 39.6 | 0 | | CRVI, SCGR | 2 | 11.7 | 16.9 |
| Riparian | 3667 | 16.3 | 0 | | CRVI, PICA, THEL | 3 | 12.7 | 18.4 |
| Desert Shrubland | 3330 | 14.8 | 0 | | CRVI, SCGR | 2 | 6.3 | 9.0 |
| Grassland | 1912 | 8.5 | 0 | | SCGR | 1 | 3.4 | 5.0 |
| Coniferous Woodland | 1350 | 6.0 | 0 | | | 0 | 1.3 | 1.8 |
| Sagebrush Steppe | 2633 | 11.7 | 0 | | SCGR | 1 | 1.3 | 1.9 |
| Great Plains Shrubland | 23 | 0.1 | 0 | | | 0 | 0.0 | 0.0 |
| Agriculture | 382 | 1.7 | 0 | | | 0 | 0.0 | 0.0 |
| Disturbed/Barren | N/A | N/A | 0 | | CRVI, PICA, SCGR, THEL | 4 | 9.0 | 13.1 |
| Totals: | 22,094 | 100.0 | | | | | 68.8 | 100.0 |

* Area within Bighorn Canyon National Recreation Area.

¹Species codes:

BUWO – *Bufo woodhousii*

PSMA – *Pseudacris maculata*

RAPI – *Rana pipiens*

SCGR – *Sceloporus graciosus*

PICA – *Pituophis catenifer*

THEL – *Thamnophis elegans*

CRVI – *Crotalus viridi*

Table 8. A list of the terrestrial funnel trap sites with the species and number of each species captured per site, the total number of trapping days, location names, habitat types, elevation and UTM locations. Refer to Figure 5 for a map of these locations.

| Start Date | Stop Date | Trap Site | Location | Habitat Type | UTM Zone | Easting | Northing | Elevation (m) | Captures | Total Trap Days |
|------------|-----------|-----------|-------------------|-----------------------|----------|---------|----------|---------------|--------------------|-----------------|
| 09 Aug 01 | 13 Aug 01 | Trap 1 | West Sykes Mtn. | Desert shrubland | 12N | 0713572 | 4980908 | 1165 | CRVI (1), SCGR (1) | 5 |
| 09 Aug 01 | 13 Aug 01 | Trap 2 | Crooked Creek | Riparian vegetation | 12N | 0715624 | 4982702 | 1107 | 0 | 5 |
| 09 Aug 01 | 13 Aug 01 | Trap 3 | State Line | Juniper/Mtn. mahogany | 12N | 0715053 | 4989078 | 1398 | 0 | 5 |
| 09 Aug 01 | 13 Aug 01 | Trap 4 | Ewing-Snell Ranch | Riparian vegetation | 12N | 0715334 | 4995788 | 1329 | CRVI (1) | 5 |
| 10 Aug 01 | 13 Aug 01 | Trap 5 | Trail Creek | Riparian vegetation | 12N | 0717628 | 4998417 | 1172 | 0 | 4 |
| 10 Aug 01 | 13 Aug 01 | Trap 6a | Hillsboro | Disturbed/Barren | 12N | 0717410 | 4997658 | 1208 | SCGR (1) | 4 |
| 10 Aug 01 | 13 Aug 01 | Trap 6b | Hillsboro | Riparian vegetation | 12N | 0717581 | 4997622 | 1208 | 0 | 4 |
| 10 Aug 01 | 13 Aug 01 | Trap 6c | Hillsboro | Riparian vegetation | 12N | 0717443 | 4997610 | 1189 | 0 | 4 |

SCGR – *Sceloporus graciosus*

CRVI – *Crotalus viridi*

Figures

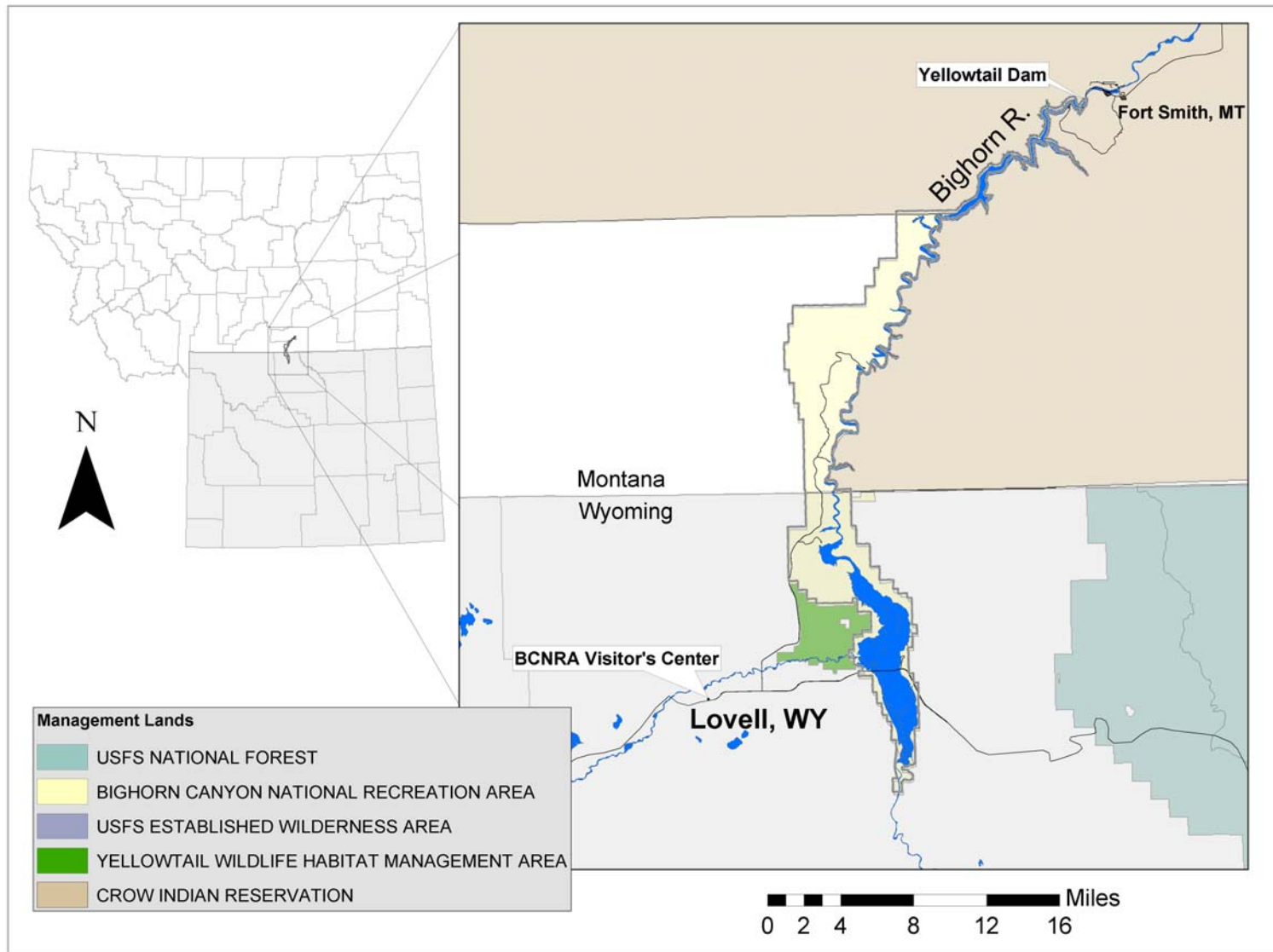


Figure 1. Location of Bighorn Canyon National Recreation Area.

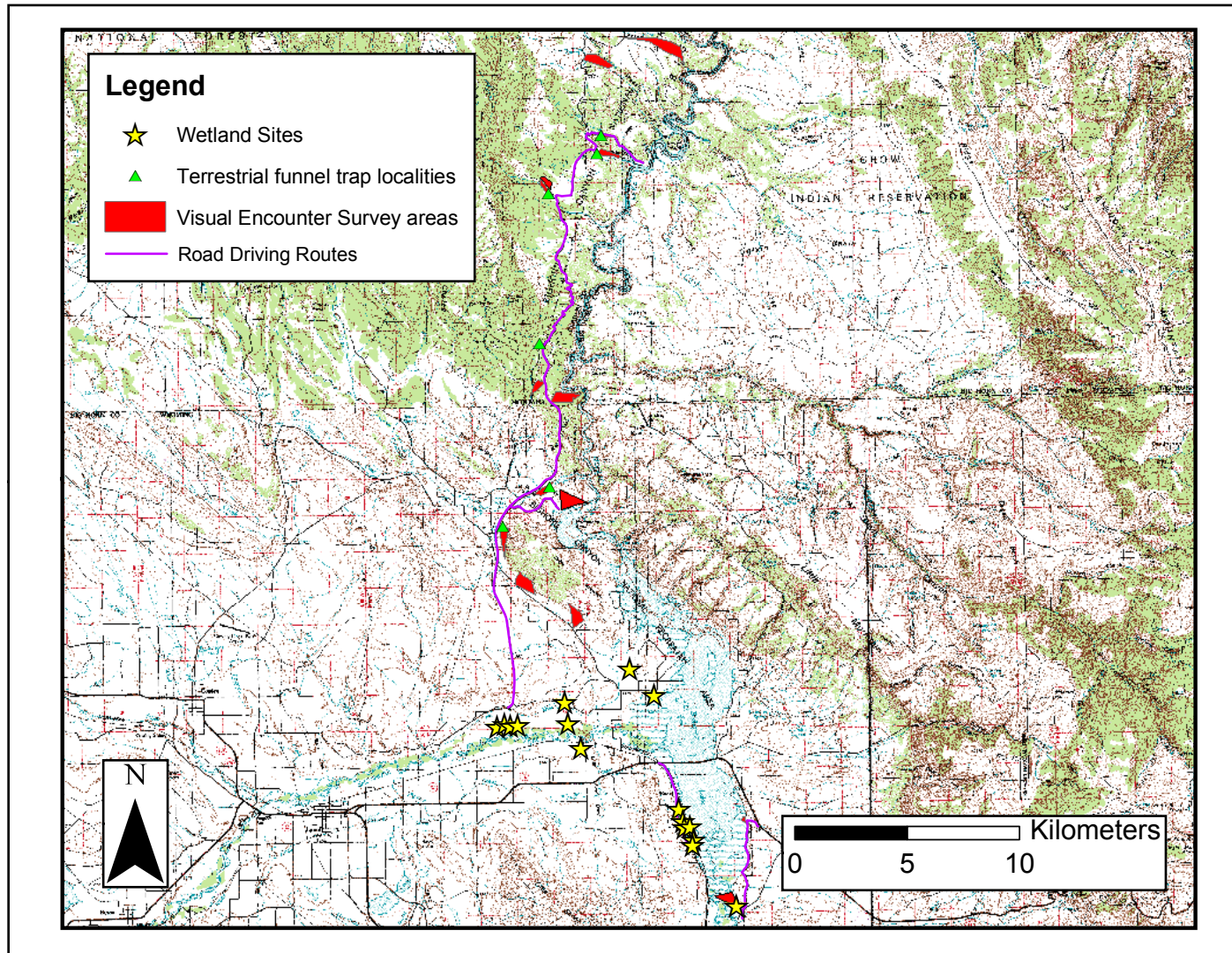


Figure 2. The sampling locations for the survey methods used in Bighorn Canyon. This map covers the southern portion of the study area (Pwell Quadrangle, Wyo. 100k series).

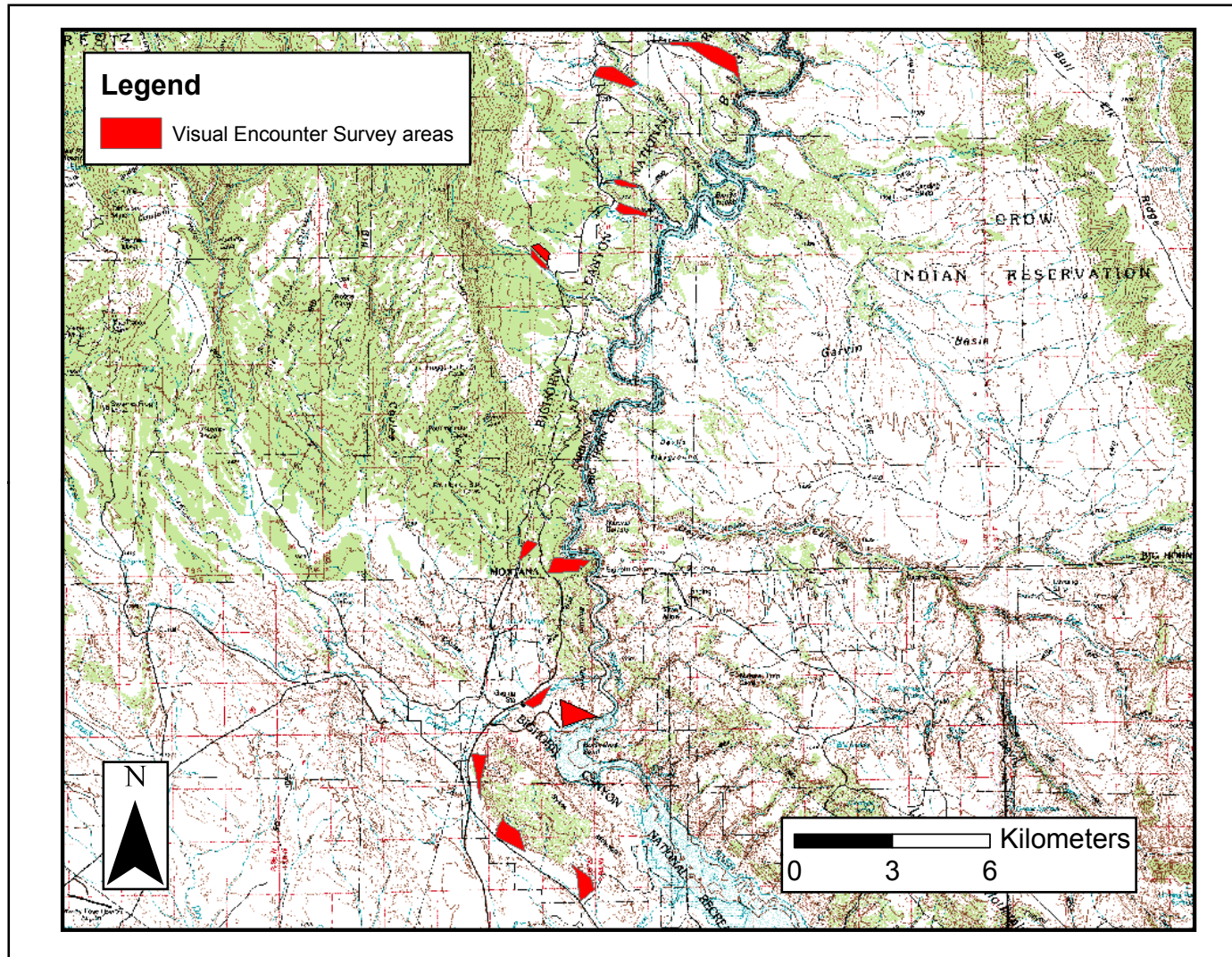


Figure 3a. Upland Visual Encounter Survey locations. Sykes Mountain and Horseshoe Bend are located at the south end of the map (Powell Quadrangle, Wyo. 100k series) with Upper Layout Creek and the Ewing-Snell Ranch at the north end (Bridger Quadrangle, Mont. 100k series).

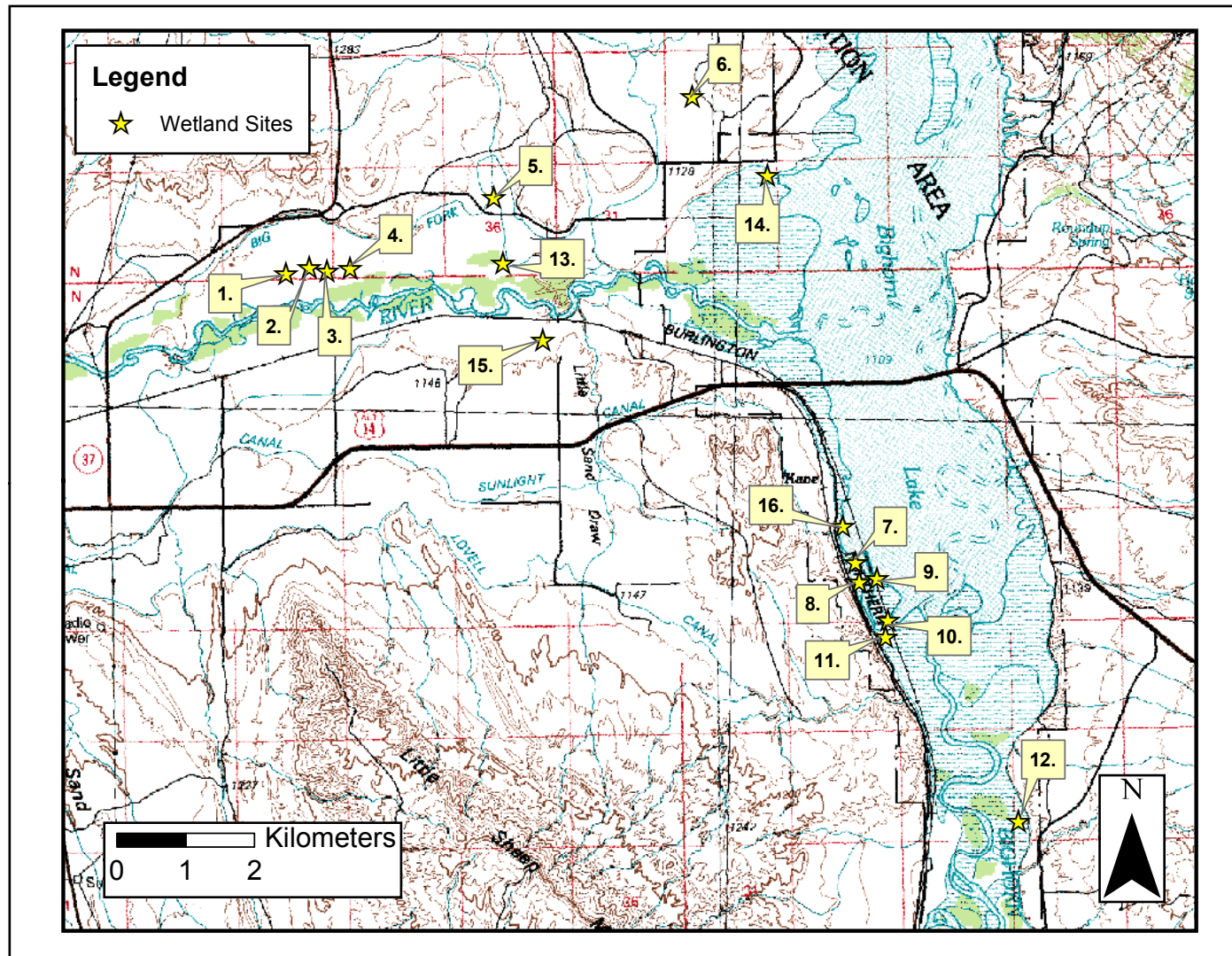


Figure 4. Visual Encounter Survey data sheet.

AMPHIBIAN SURVEY DATA SHEET - modified after S.P. Corn, NBS, Fort Collins, CO

(ver. 1 May 1996)

Herpetology Laboratory, Idaho State University and Idaho Museum of Natural History, Box 8007, Pocatello, ID 83209
(208) 236-3922 voice 236-4570 FAX e-mail: petechar@isu.edu

| | | | | | | | | |
|--|-------------------|---|---------------------|--|------------------------------------|-------------------------------|-------------------------|-----------|
| DATE | | BEGIN TIME | | END TIME | | OBSERVERS | | |
| LOCALITY | | | | | | | | |
| STATE | | COUNTY | | MAP NAME | | OWNER | | ELEVATION |
| T | R | S | | UTM ZONE/DATUM | | NORTHING | | EASTING |
| AMPHIBIAN AND REPTILE SPECIES PRESENT (INDICATE NUMBERS IN CATEGORIES IF POSSIBLE) | | | | | | | | |
| SPECIES | ADULT | JUVENILE | METAM. | LARVAE | EGGS | CALLING | TECHNIQUE(S) | VOUCHER |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| FISH PRESENT | | YES ??? NO | | FISH SPECIES: | | | | |
| ENTIRE SITE SEARCHED? | | YES NO | | IF NO, IDICATE AREA: meters of shoreline habitat | | | | |
| WEATHER: | RADIATION: | | CLEAR | PARTIAL | OVERCAST | WIND: CALM LIGHT MEDIUM HEAVY | | |
| AIR TEMPERATURE (1 M SHADED) | | | °C OR F | | % CLOUD COVER: | | PRECIPTATION: SNOW RAIN | |
| WATER | TEMPERATURE (1CM) | | | pH: | | CONDUCTIVITY | | SAMPLE? |
| COLOR | | CLEAR | STAINED | TURBIDITY | | CLEAR | CLOUDY | |
| SITE DESCRIPTION | | PUT SKETCH AND ADDITIONAL COMMENTS ON BACK OF SHEET | | | | | | |
| ORIGIN | NATURAL | MAN-MADE | MAN-MODIFIED | DRAINAGE | | PERMANENT | OCCASIONAL | NONE |
| SITE TYPE TEMPORARY or PERMANENT LAKE/POND MARSH BOG STREAM SPRING/SEEP ACTIVE or INACTIVE BEAVER POND | | | | | | | | |
| NATIONAL WETLAND INVENTORY CLASIFICATION | | | | | GAP ANALYSIS COVER TYPE (IF KNOWN) | | | |
| STREAM ORDER | | 1 | 2 | 3 | 4 | 5 | 6 | |
| SITE LENGTH m | | SITE WIDTH m | | MAXIMUM DEPTH | | < 1M | 1 - 2 M | > 2 M |
| PRIMARY SUBSTRATE SILT/MUD SAND/GRAVEL COBBLE BOULDER/BEDROCK OTHER: | | | | | | | | |
| % OF LAKE MARGIN WITH EMERGENT VEGETATION 0 1 - 25 25 - 50 >50 | | | | | | | | |
| EMERGENT VEGETATION SPECIES (IN ORDER OF ABUNDANCE) | | | | | | | | |
| NORTH SHORELINE CHARACTERISTICS | | | SHALLOWS PRESENT | SHALLOWS ABSENT | EMERGENT VEG PRESENT | | EMERGENT VEG ABSENT | |
| DISTANCE TO FOREST EDGE m | | | FOREST TREE SPECIES | | | | | |

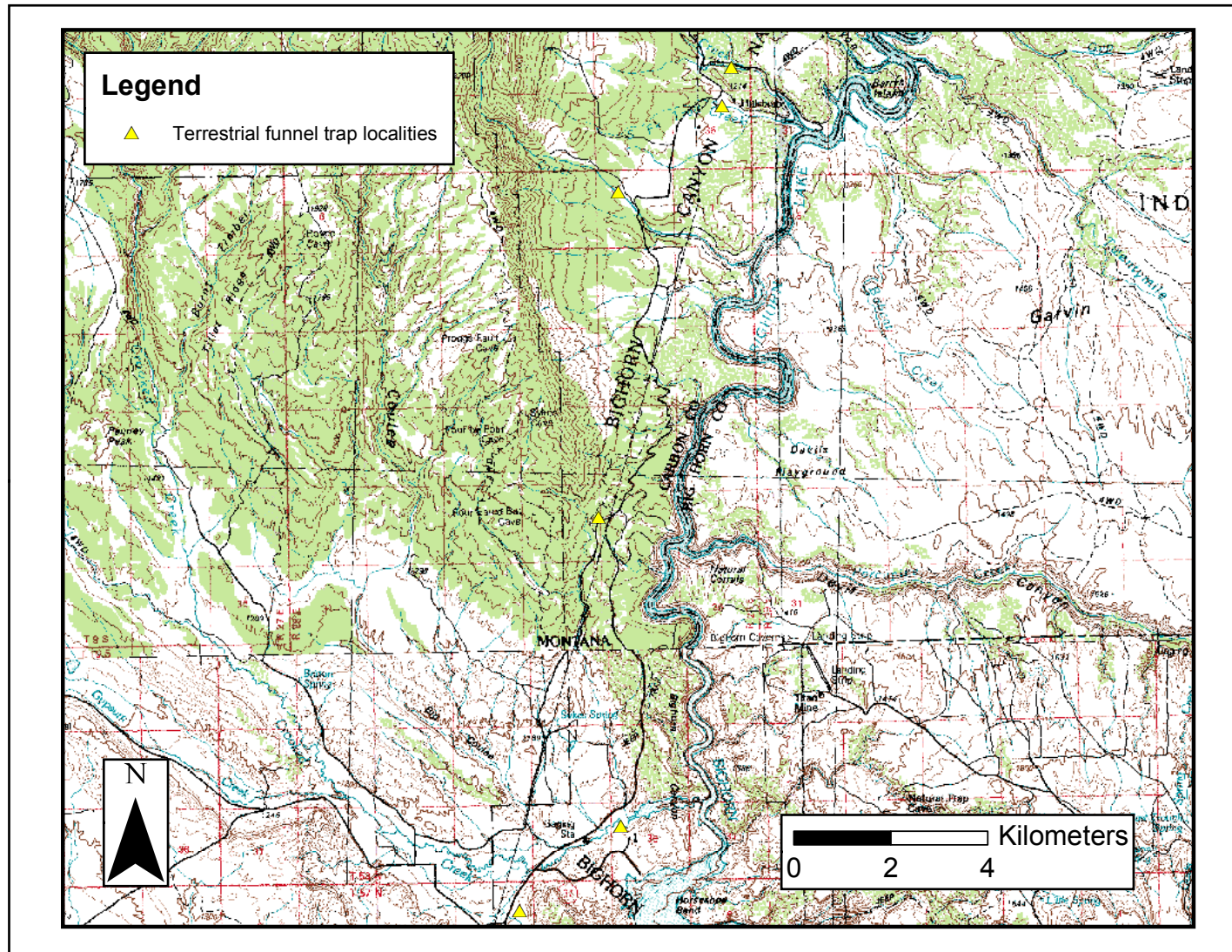


Figure 5. Terrestrial Funnel Trap localities. This map includes Sykes Mountain and Horseshoe Bend at the south end (Powell Quadrangle, Wyo. 100k series) and Hillsboro at the northern end (Bridger Quadrangle, Mont. 100k series).

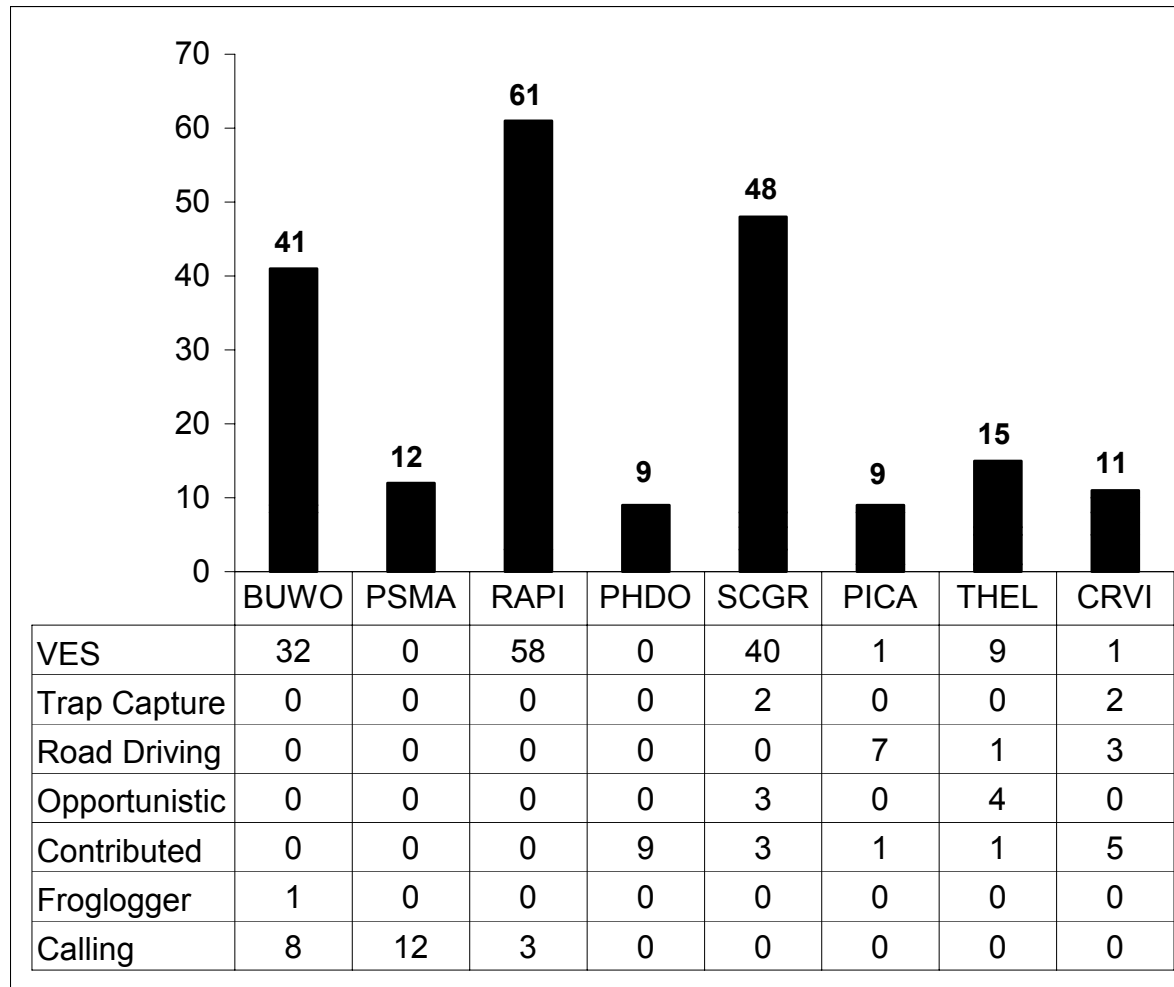


Figure 6. The total number of observations recorded by each survey method along with the number of individuals recorded per species in Bighorn Canyon National Recreation Area during the 2001 surveys (BUWO – *Bufo woodhousii*, PSMA – *Pseudacris maculata*, RAPI – *Rana pipiens*, PHDO – *Phrynosoma douglassi*, SCGR – *Sceloporus graciosus*, PICA – *Pituophis catenifer*, THEL – *Thamnophis elegans*, CRVI – *Crotalus viridis*).

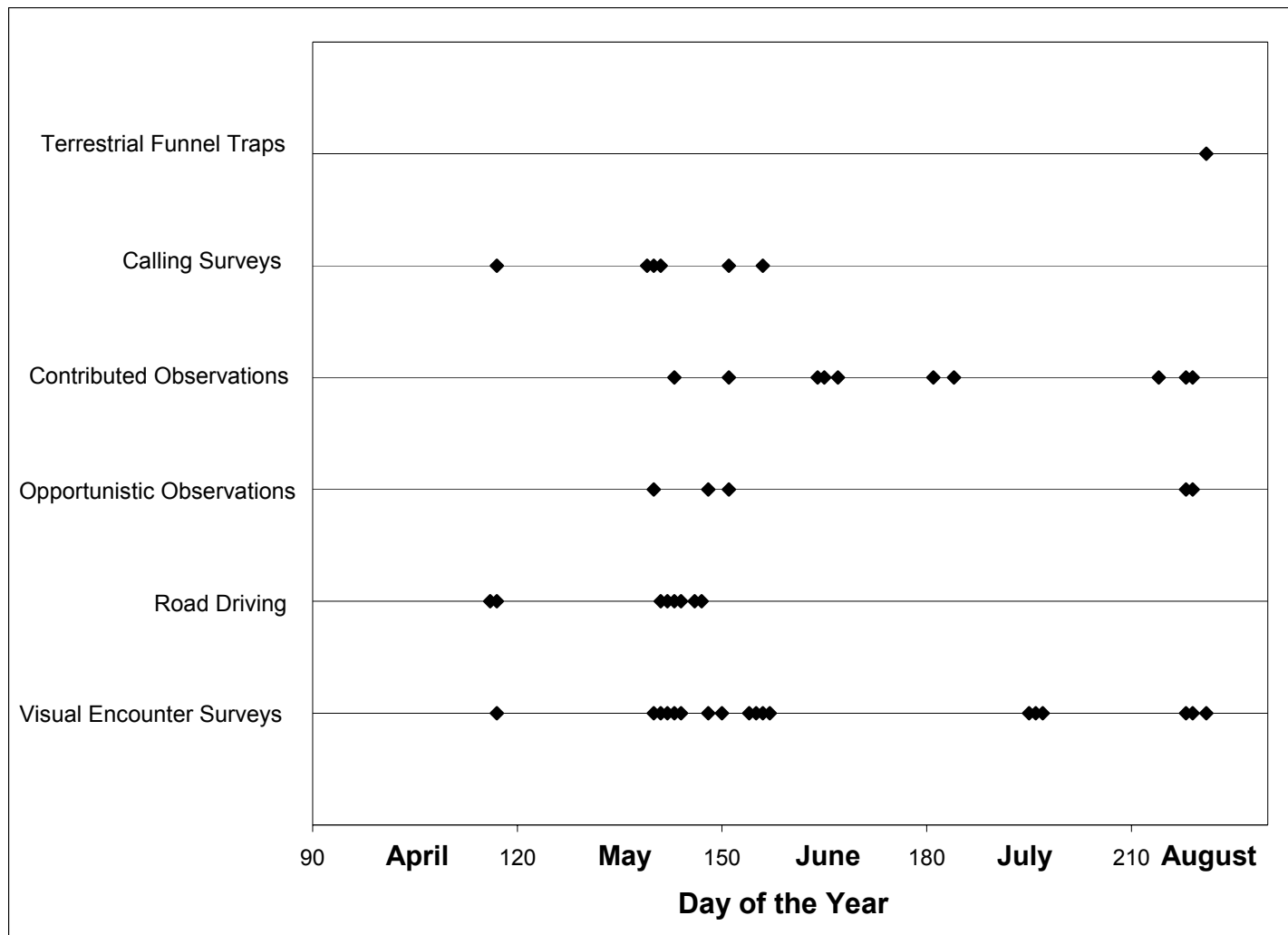


Figure 7a. The type of sampling conducted according to the day of the year.

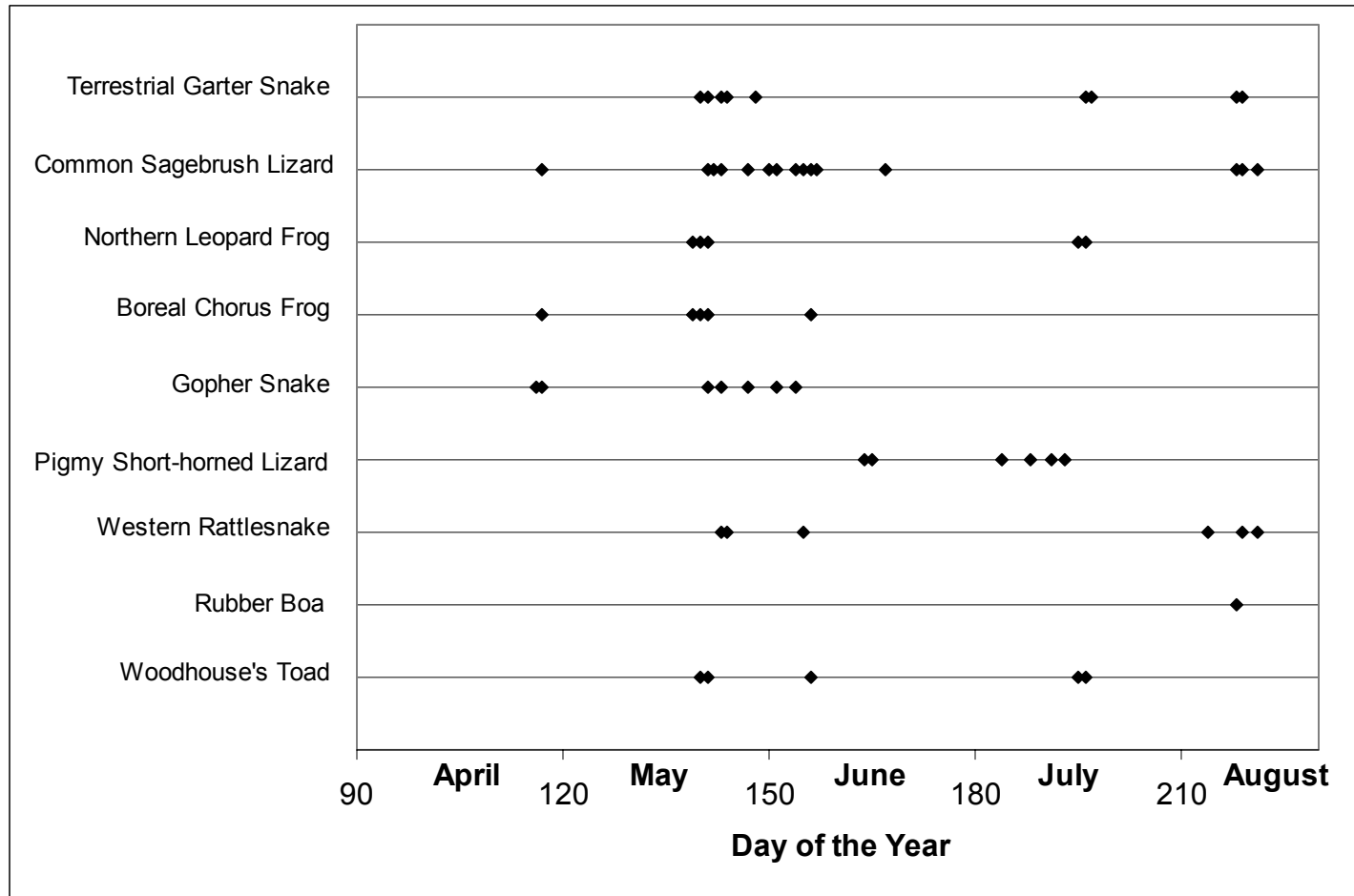


Figure 7b. Species observations according to the day of the year.

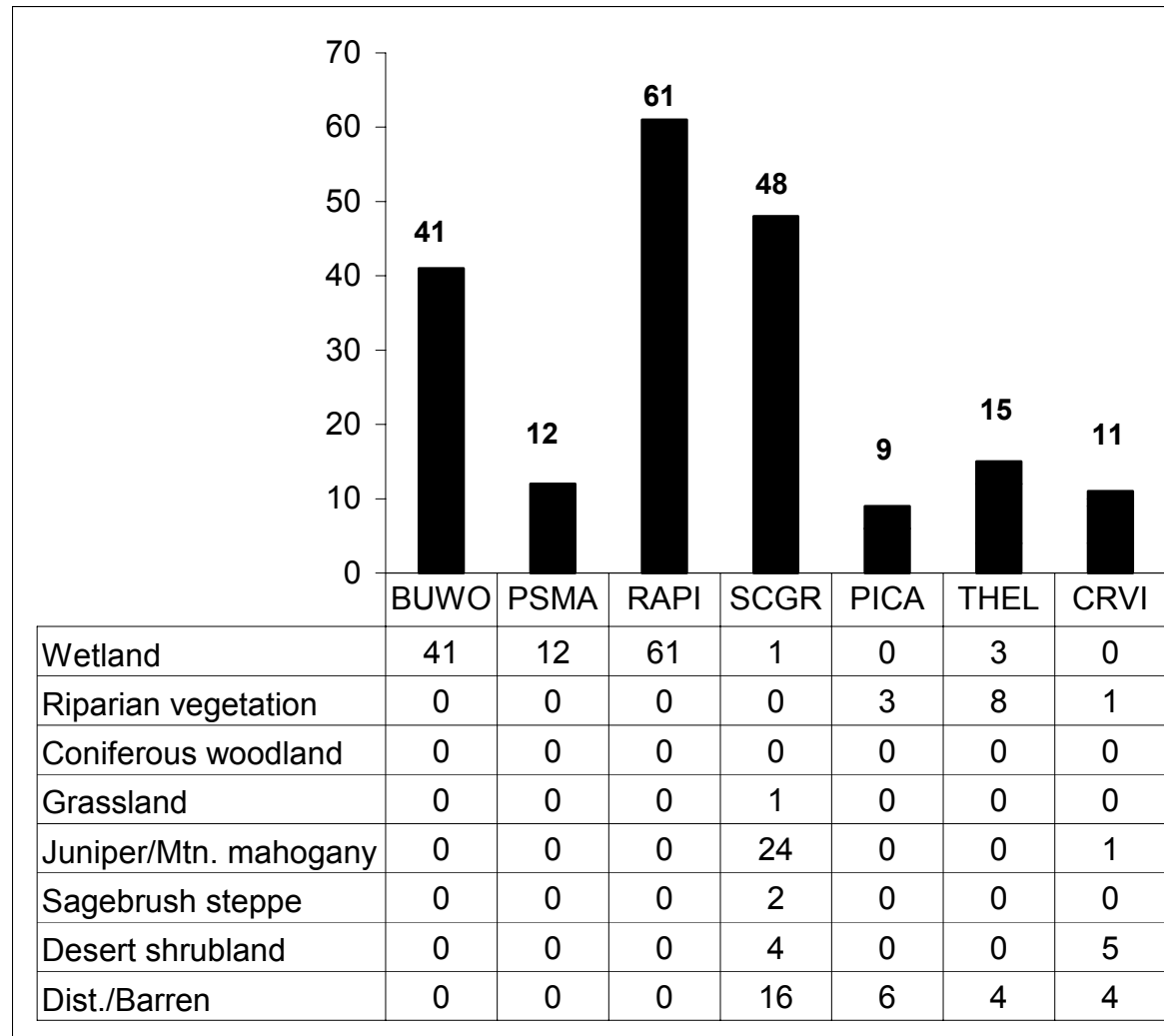


Figure 8. The total number of species observed per habitat from all survey methods used in Bighorn Canyon National Recreation Area. Contributed observations of Pigmy Short-horned Lizards or Rubber Boas are not included because habitat data was not recorded for those observations (BUWO – *Bufo woodhousii*, PSMA – *Pseudacris maculata*, RAPI – *Rana pipiens*, SCGR – *Sceloporus graciosus*, PICA – *Pituophis catenifer*, THEL – *Thamnophis elegans*, CRVI – *Crotalus viridis*).

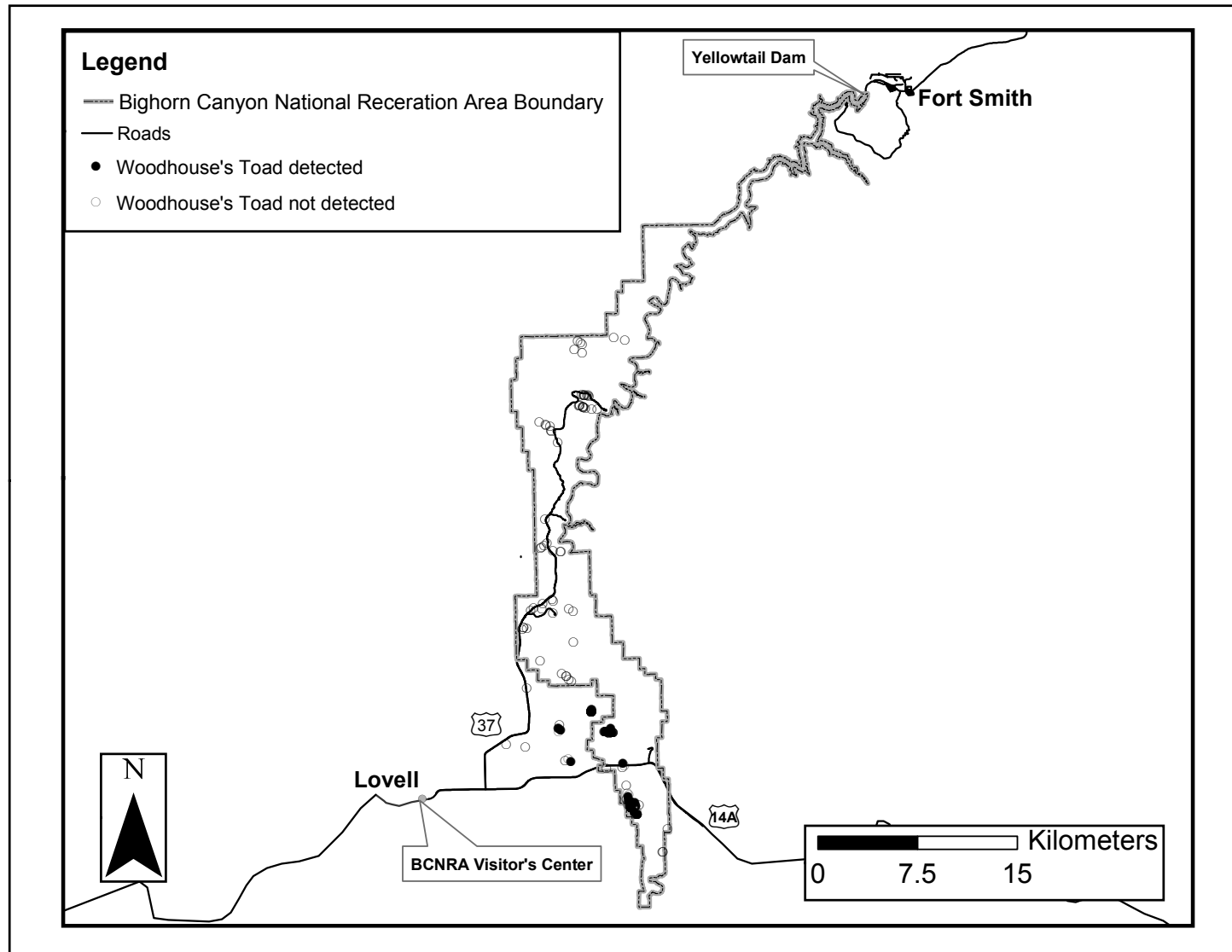


Figure 9. Woodhouse's Toad dot distribution map.

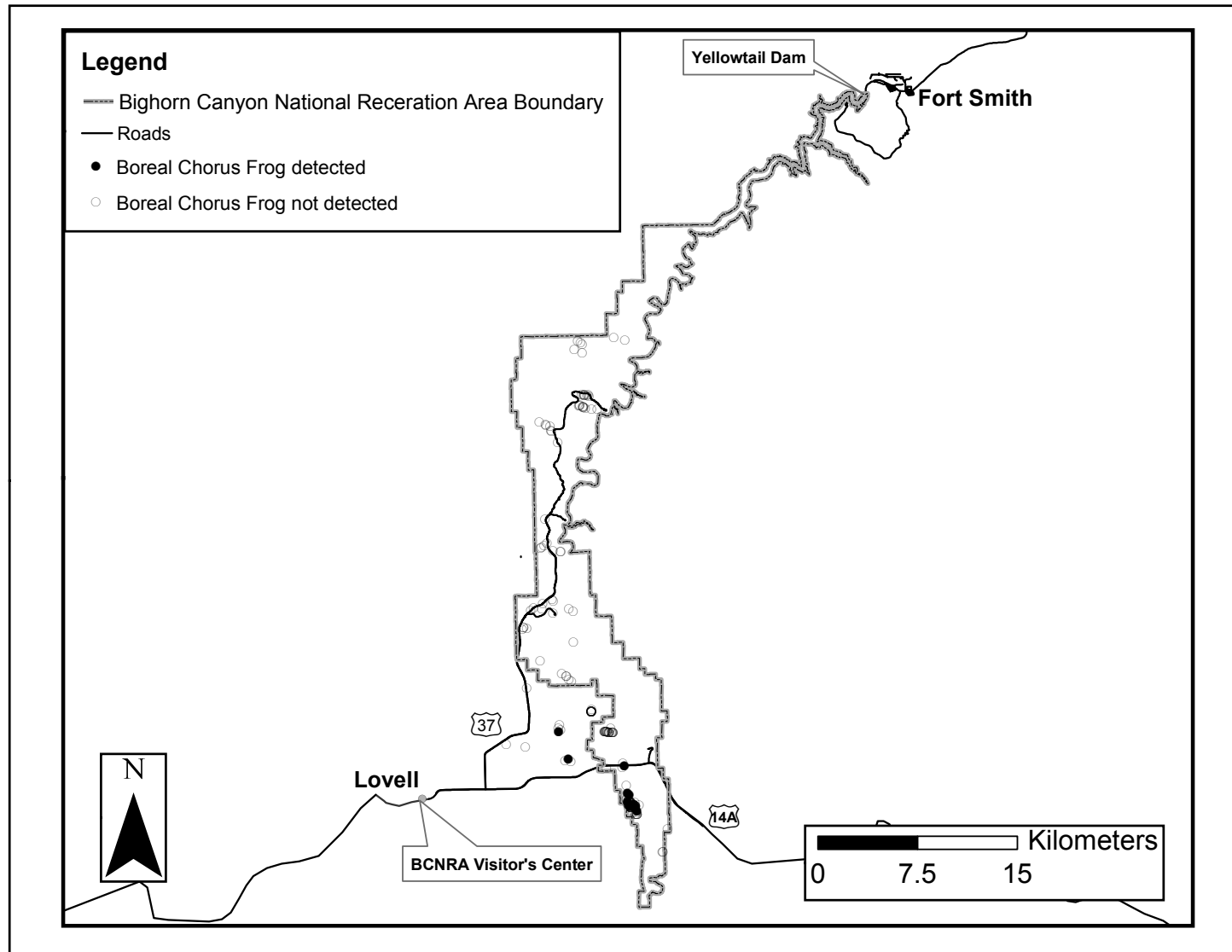


Figure 10. Boreal Chorus Frog dot distribution map.

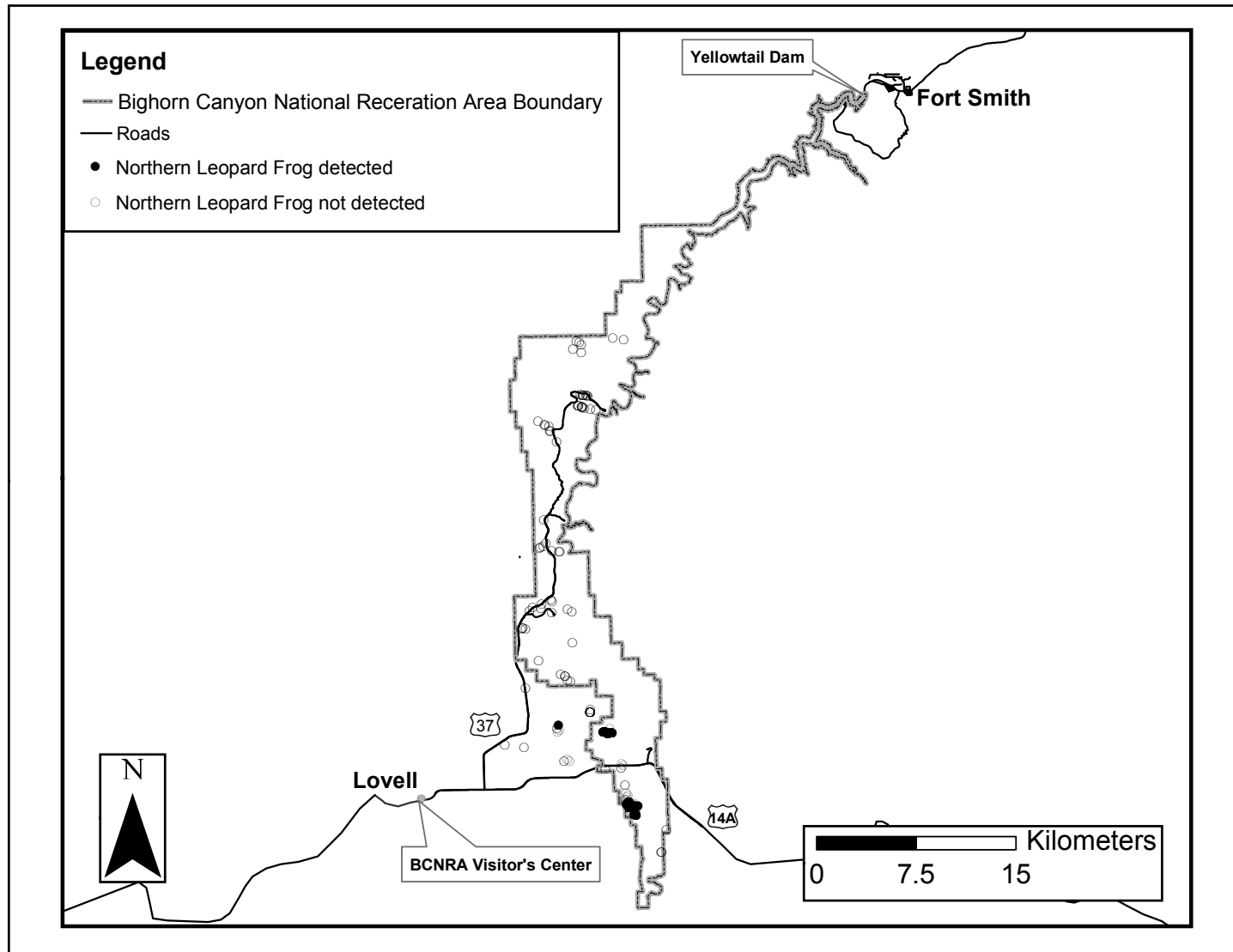


Figure 11. Northern Leopard Frog dot distribution map.

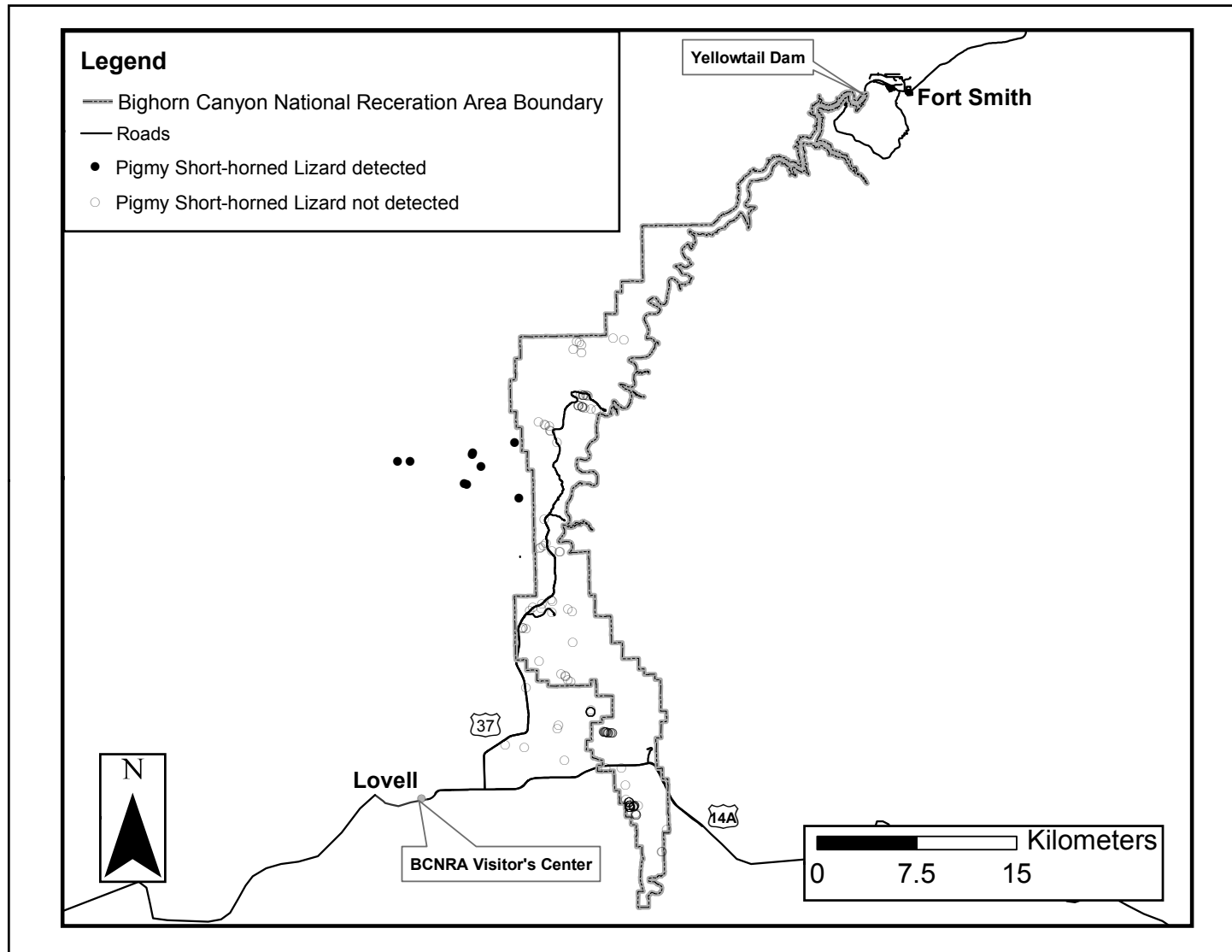


Figure 12. Pigmy Short-horned Lizard dot distribution map.

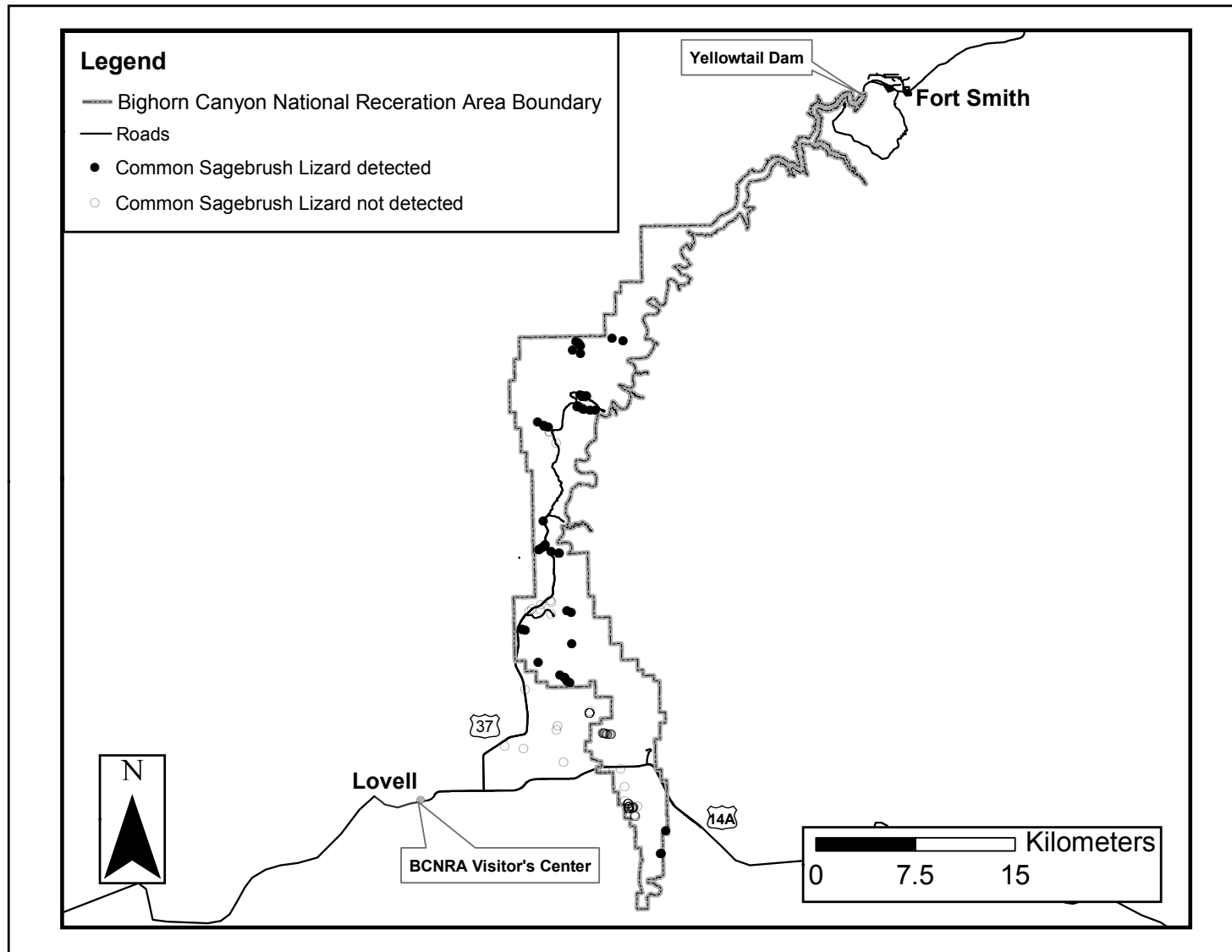


Figure 13. Common Sagebrush Lizard dot distribution map.

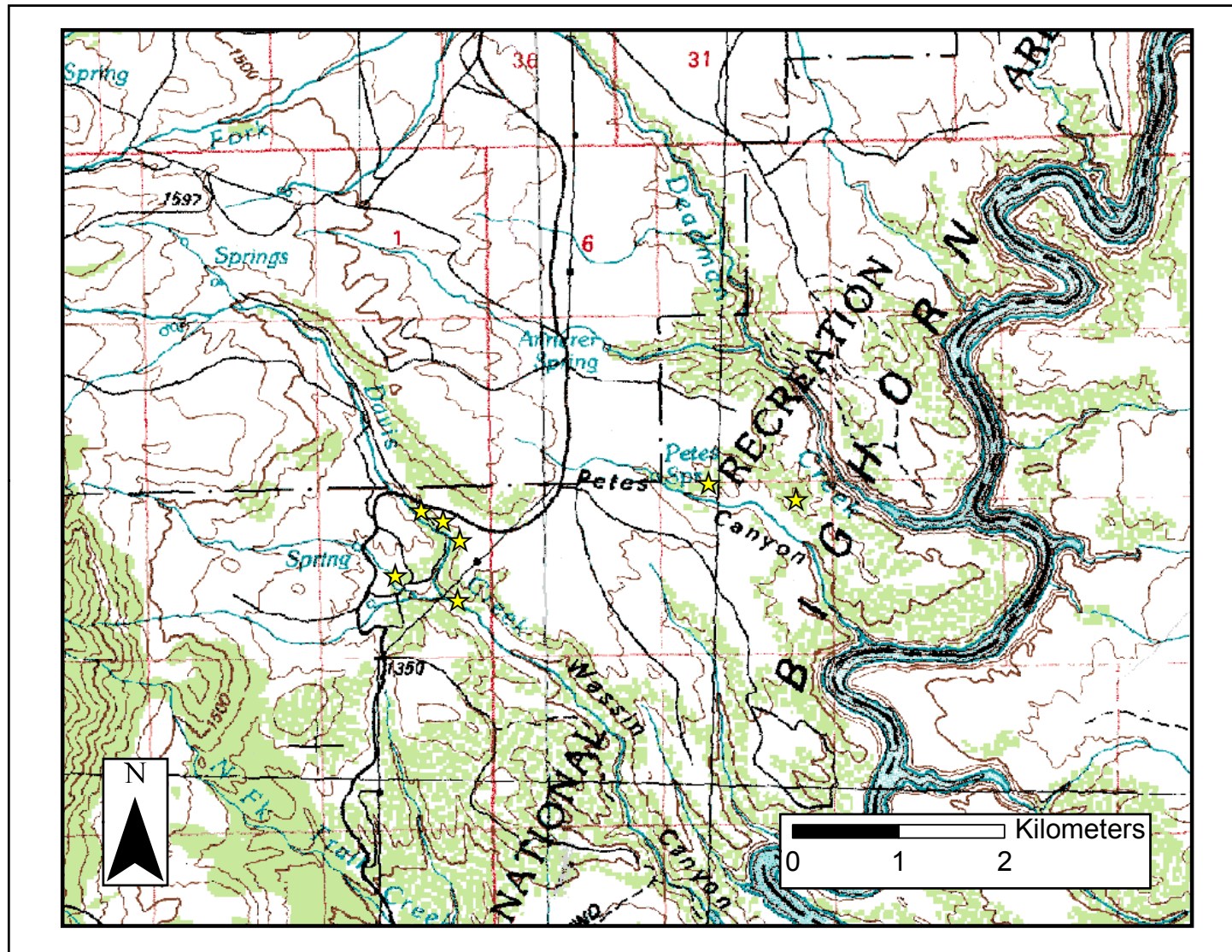


Figure 14a. Common Sagebrush Lizard distribution. This area is located northwest of Barry's Landing and includes Lockhart Ranch, Wassin Canyon, and Pete's Canyon (Bridger Quadrangle, Mont. 100k series).

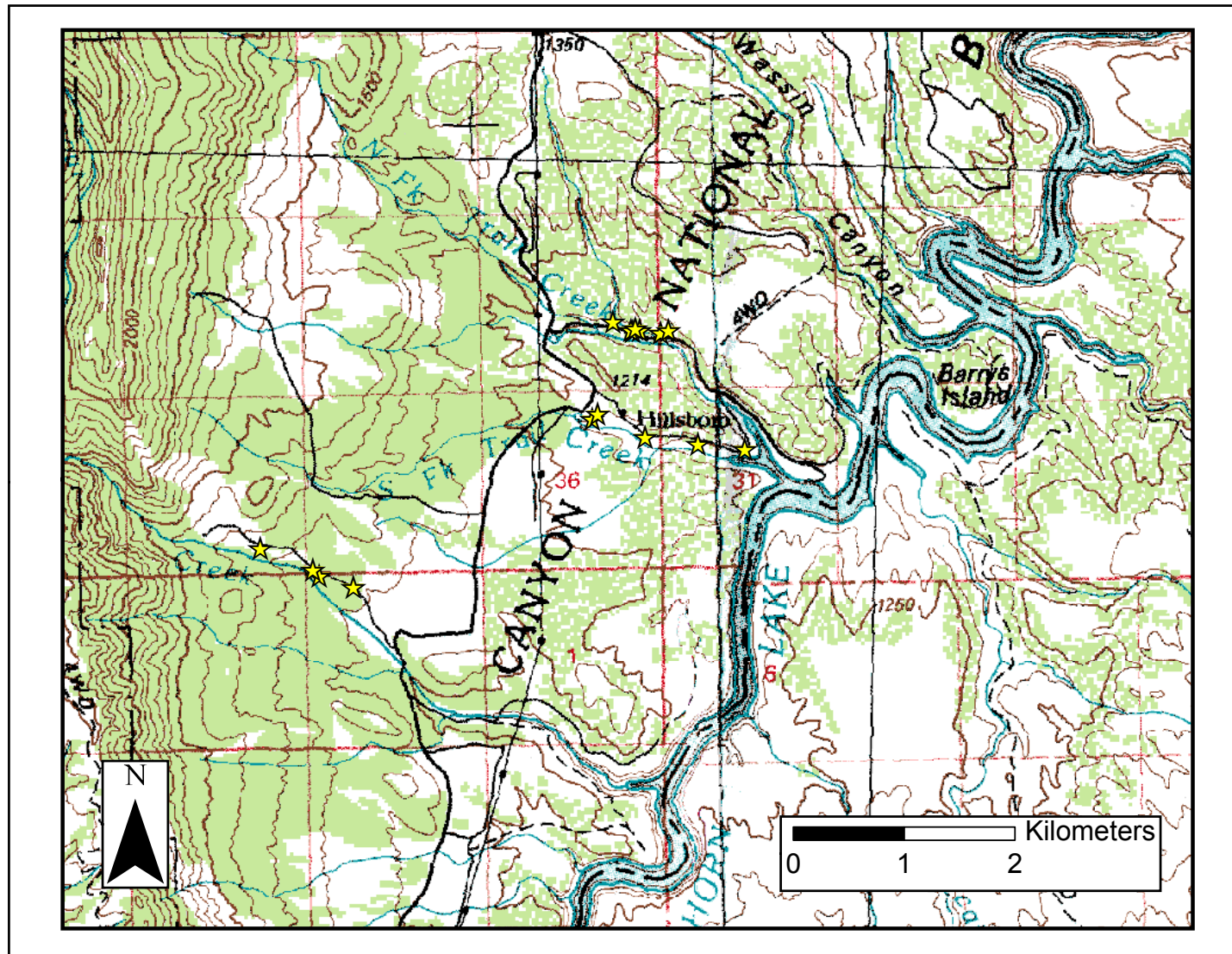


Figure 14b. Common Sagebrush Lizard distribution. This area is located west of Barry's Landing and east of Hwy 37 and includes Hillsboro at the northeast end and Upper Layout Creek at the southwest end (Bridger Quadrangle, Mont. 100k series).

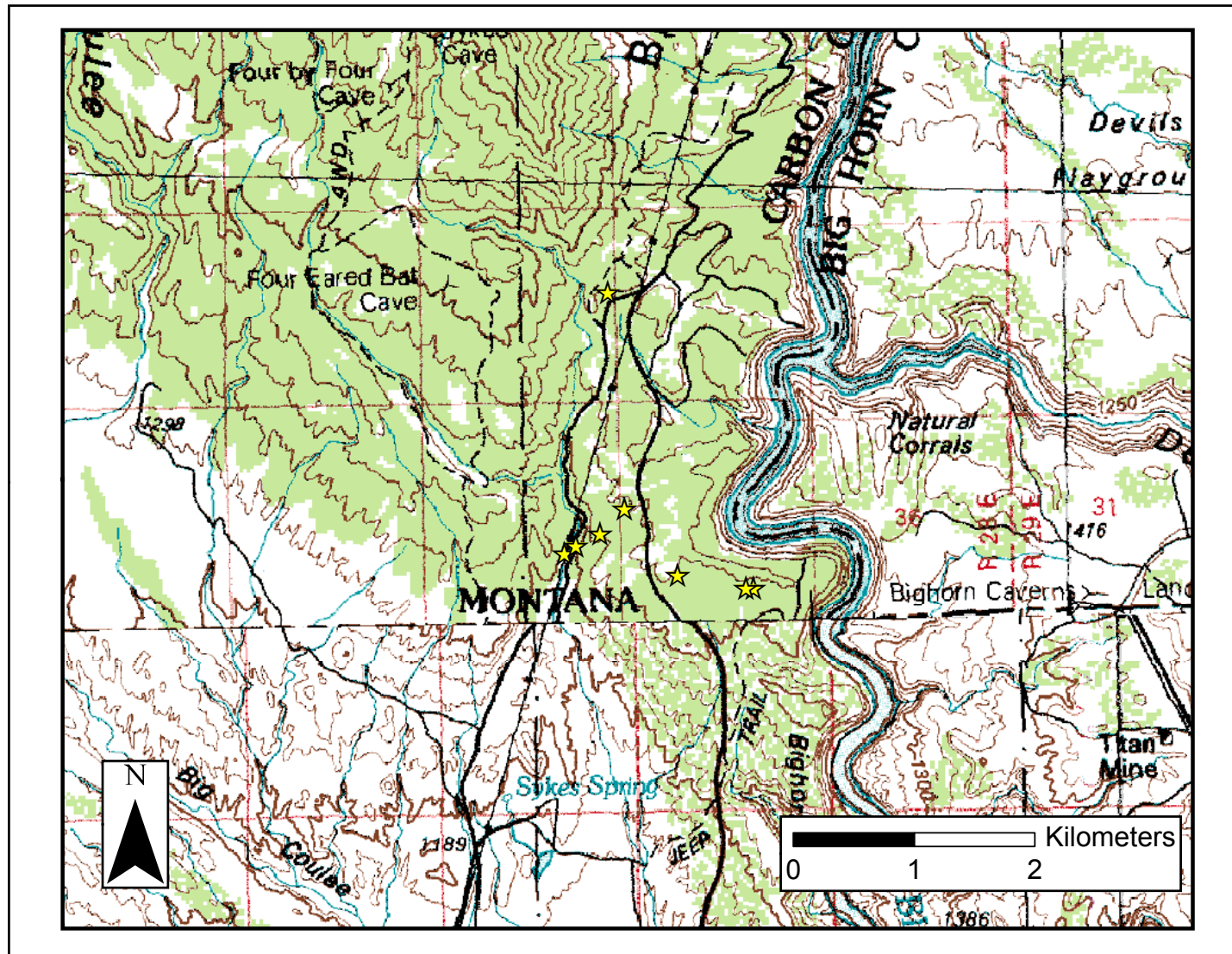


Figure 14c. Common Sagebrush Lizard distribution. This area is located at the state line between Montana and Wyoming south of Devil's Canyon overlook (Bridger Quadrangle, Mont. 100k series).

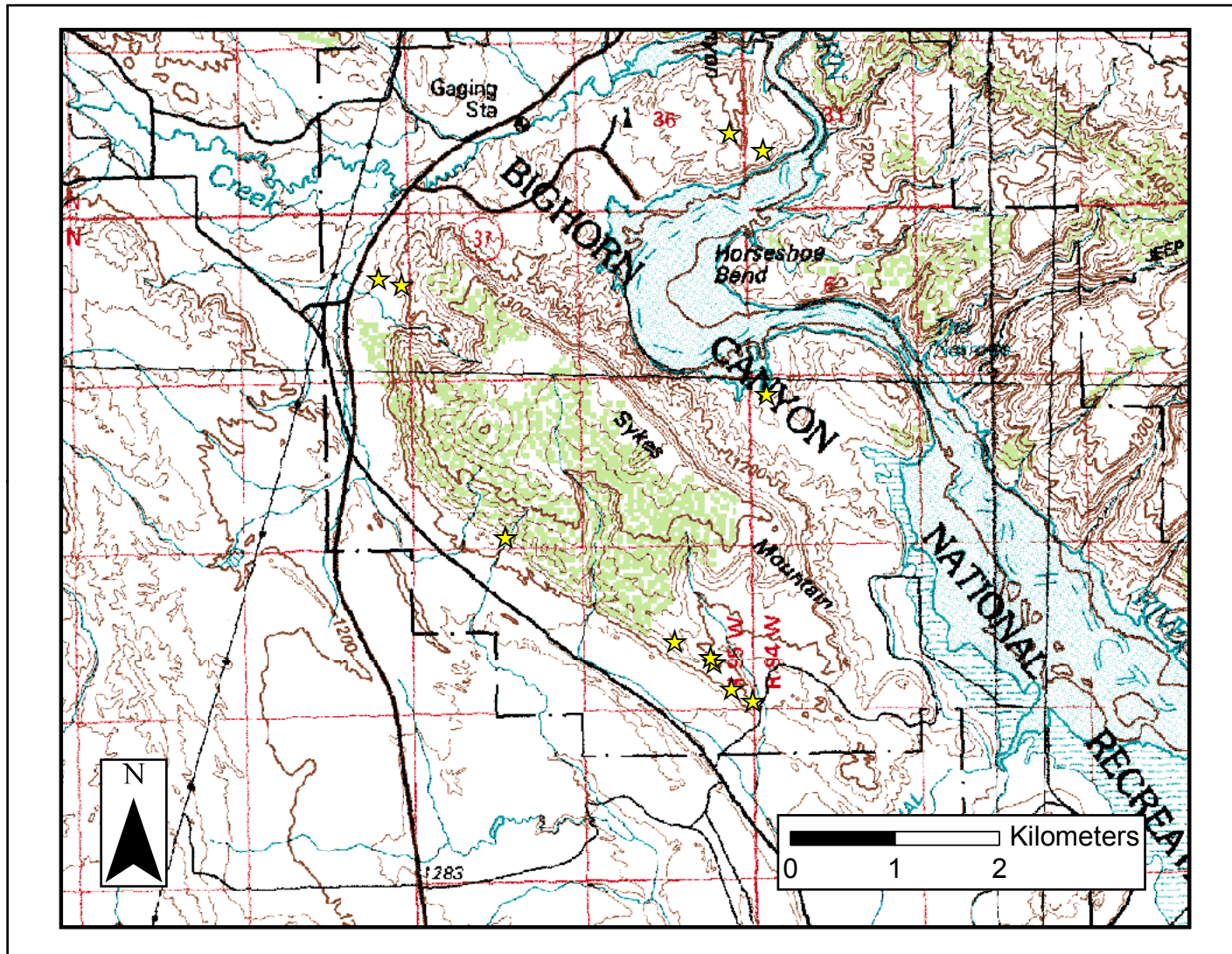


Figure 14d. Common Sagebrush Lizard distribution. This area is located east of Hwy 37 and includes Sykes Mountain and Horseshoe Bend (Powell Quadrangle, Wyo. 100k series).

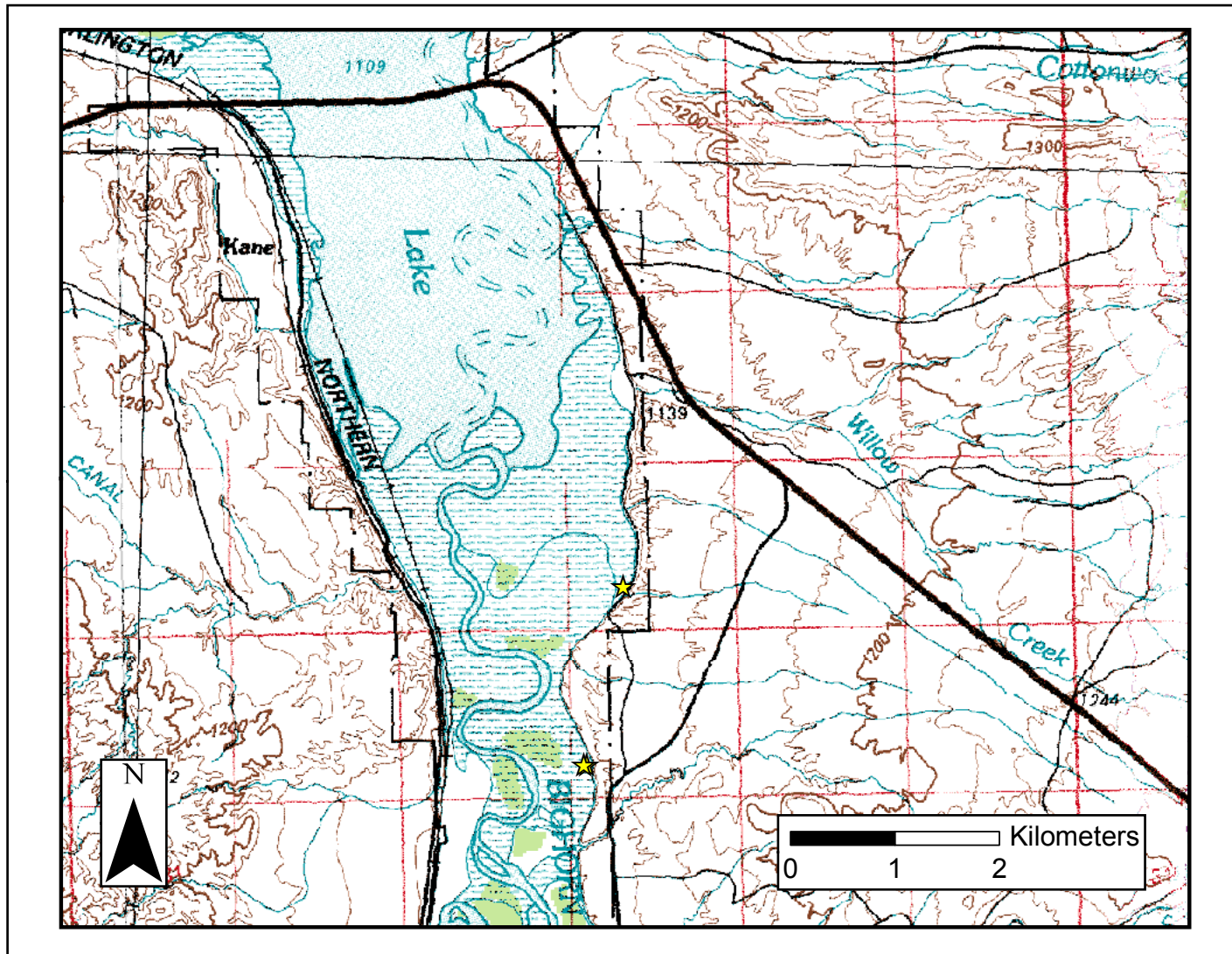


Figure 14e. Common Sagebrush Lizard distribution. This area is located at the south end of Bighorn Canyon National Recreation Area near the Mason-Lovell ranch (Powell Quadrangle, Wyo. 100k series).

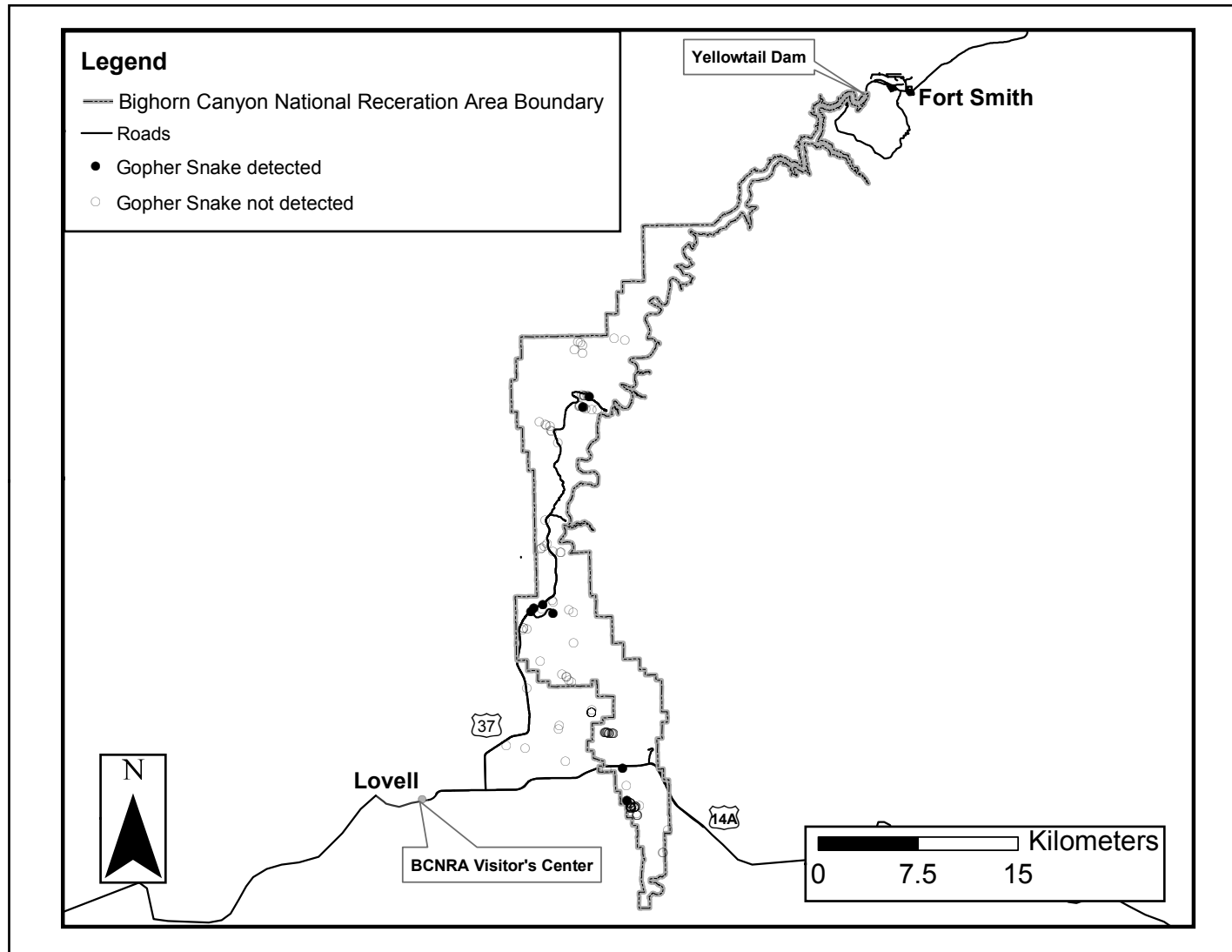


Figure 15. Gopher Snake dot distribution map.

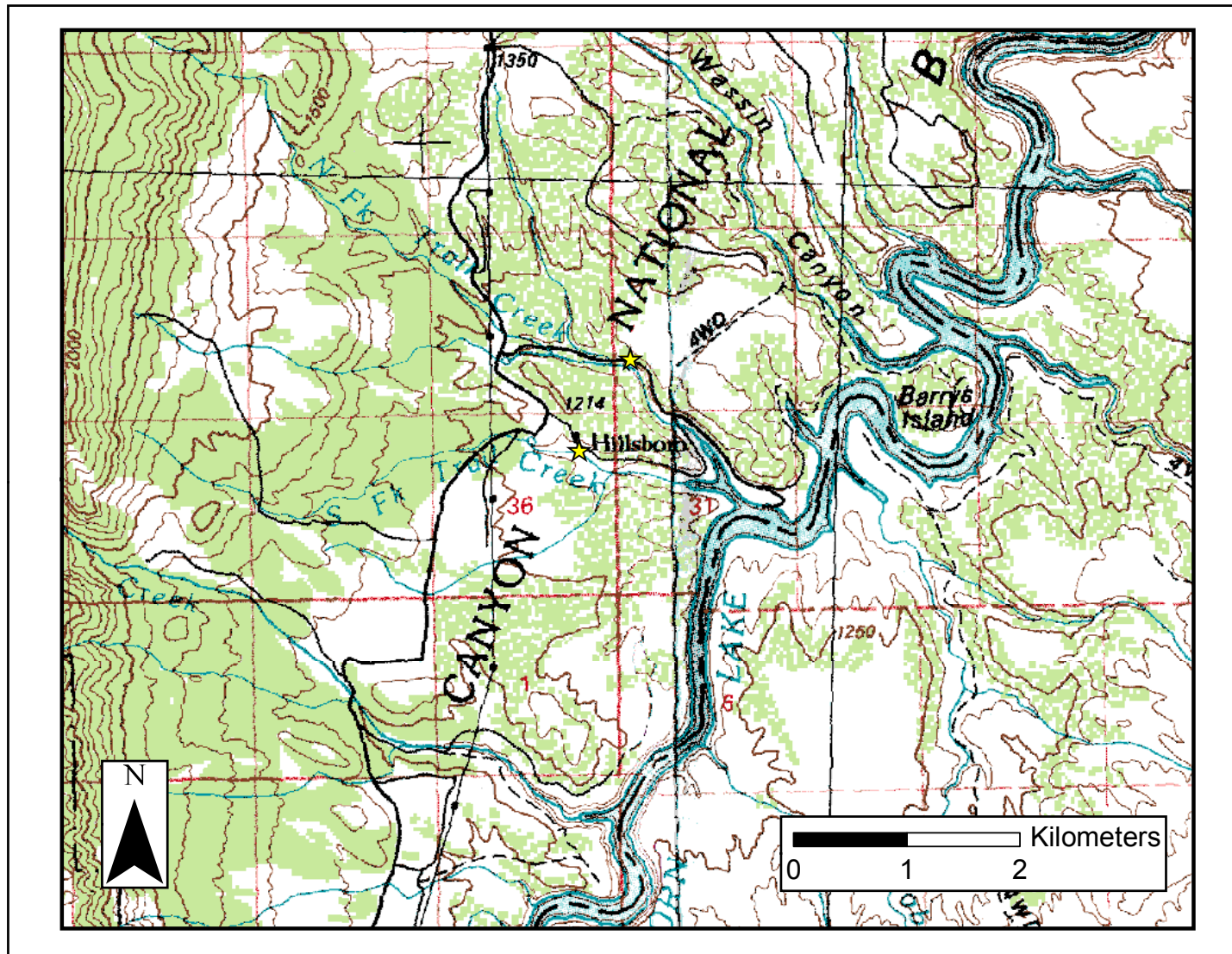


Figure 16a. Gopher Snake distribution. This map consists of the area around Barry's Landing and includes Hillsboro, and North and South Fork of Trail Creek. (Bridger Quadrangle, Mont. 100k series).

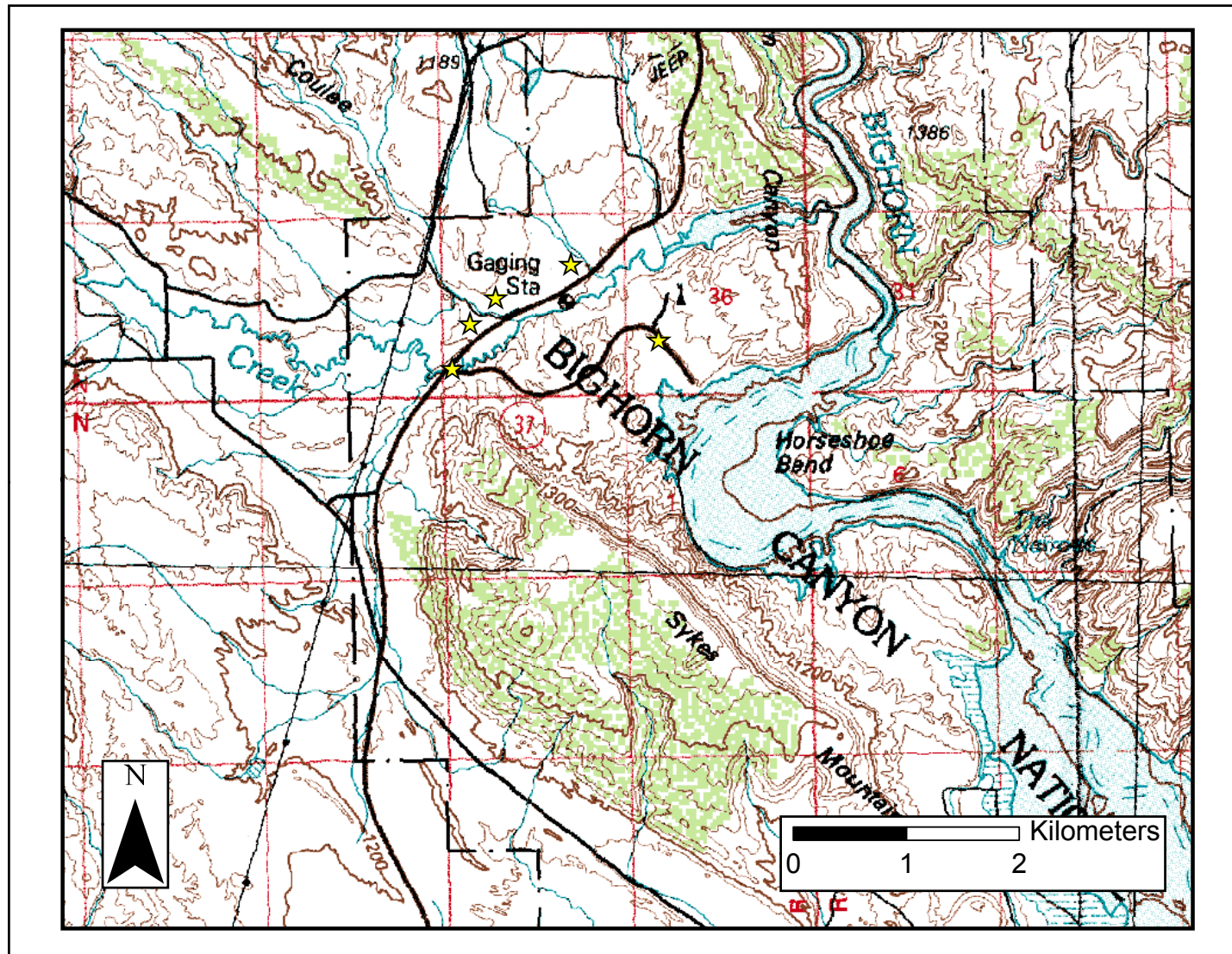


Figure 16b. Gopher Snake distribution. This map consists of the area around Horseshoe Bend and includes the northwest side of Sykes Mountain and Crooked Creek (Powell Quadrangle, Wyo. 100k series).

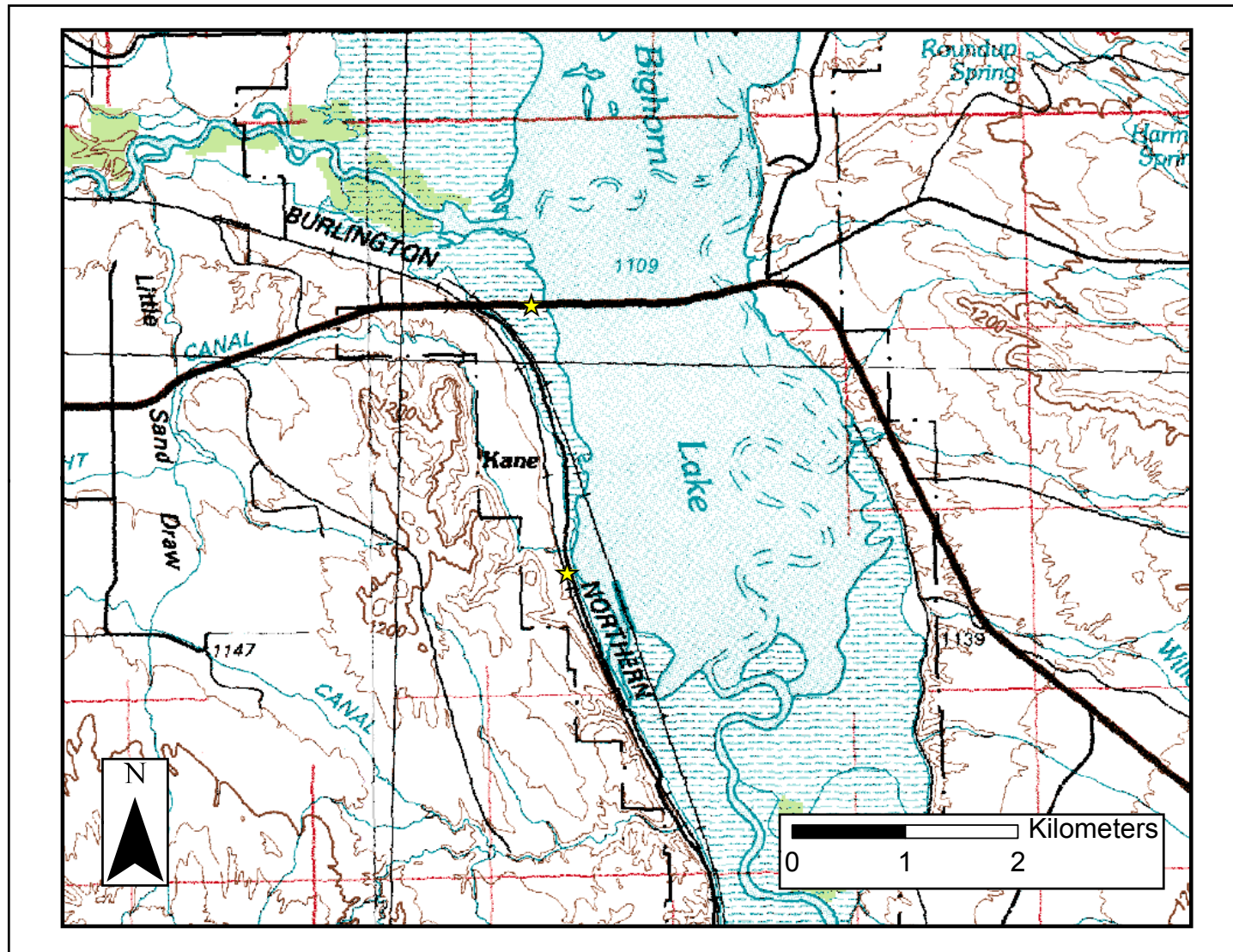


Figure 16c. Gopher Snake distribution. This area is located at the south end of Bighorn Canyon National Recreation Area (Powell Quadrangle, Wyo. 100k series).

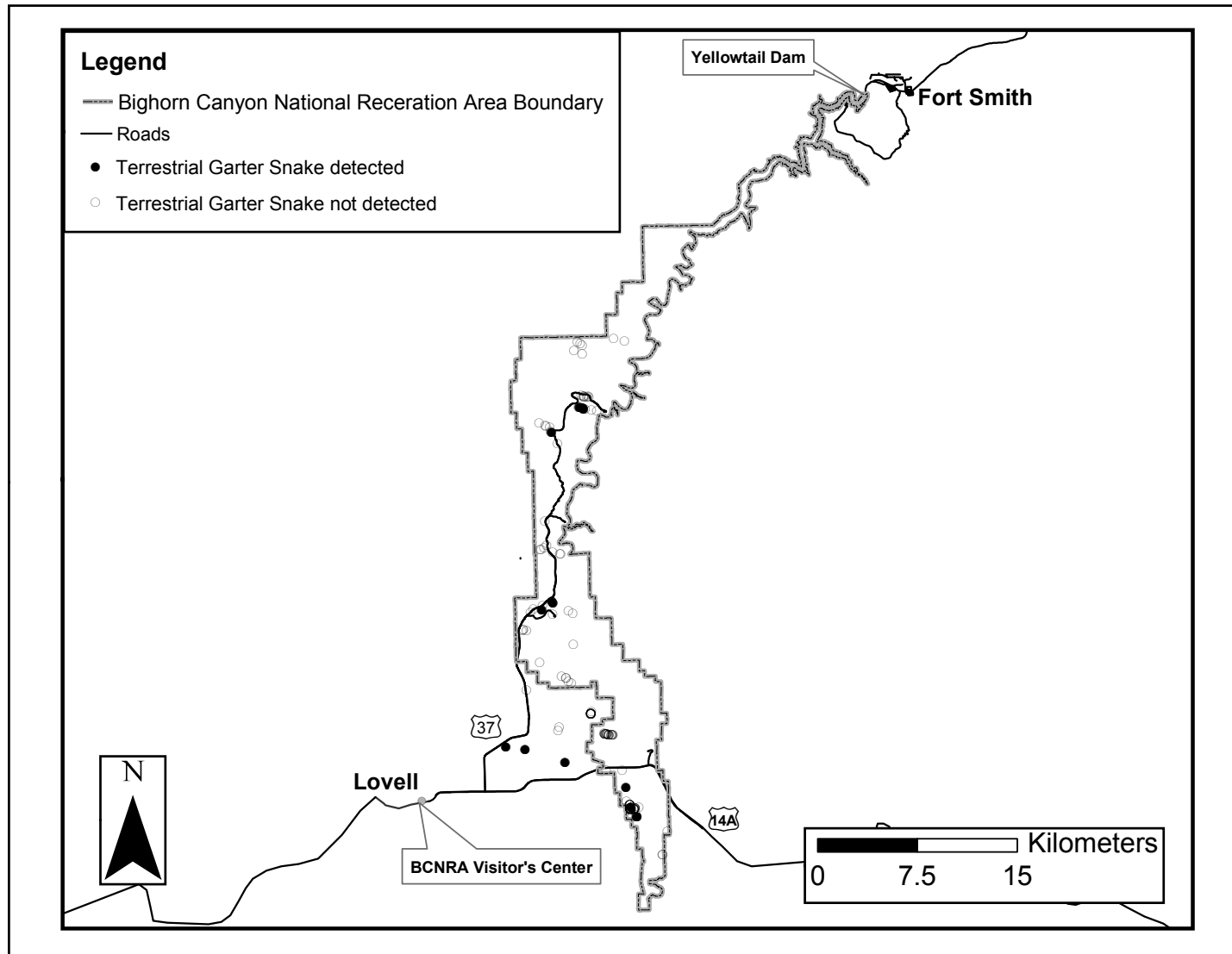
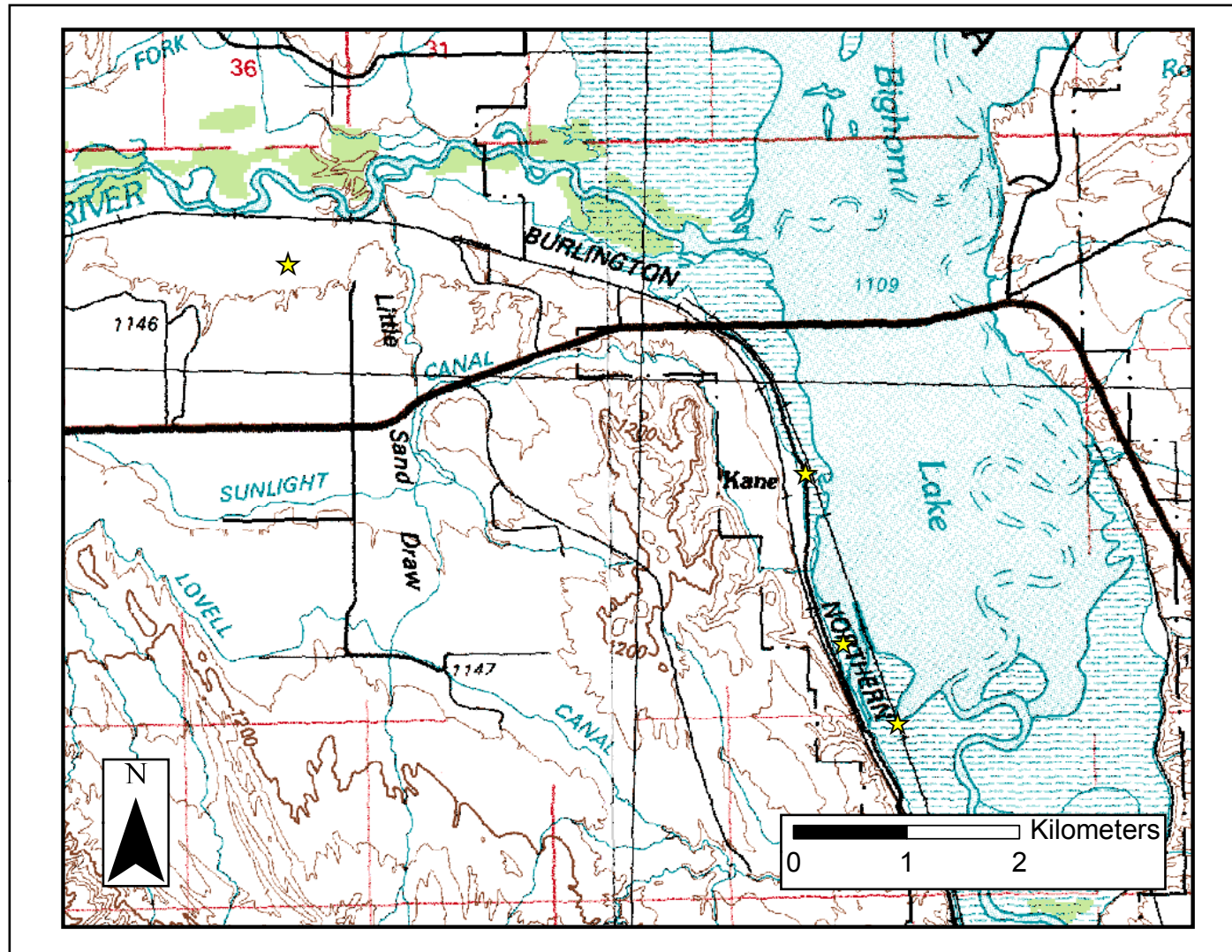


Figure 17. Terrestrial Garter Snake dot distribution.



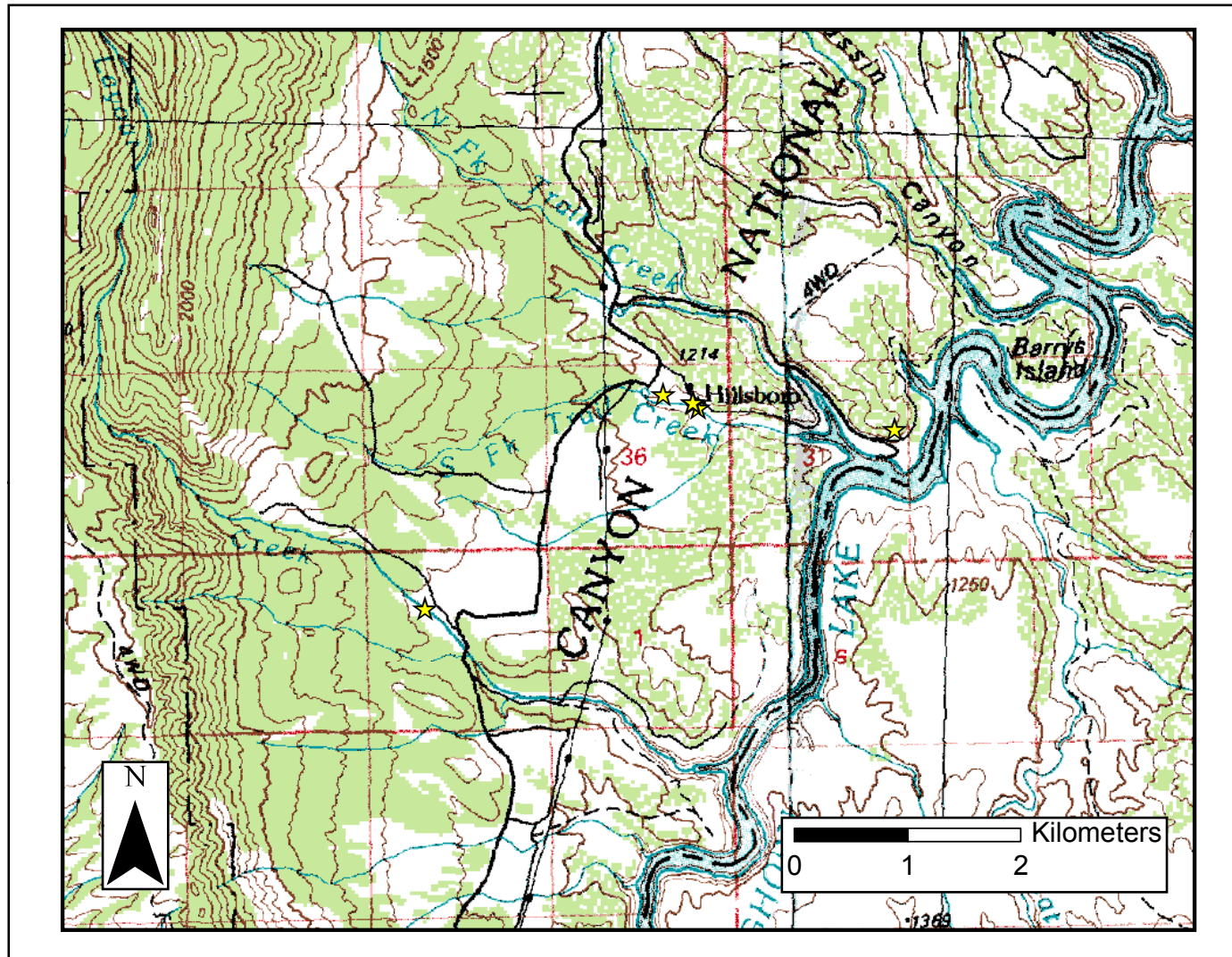


Figure 18c. Terrestrial Garter Snake distribution. This area is located west of Barry's Landing and east of Hwy 37 and includes Hillsboro at the north end and Upper Layout Creek at the southwest end (Bridger Quadrangle, Mont. 100k series).

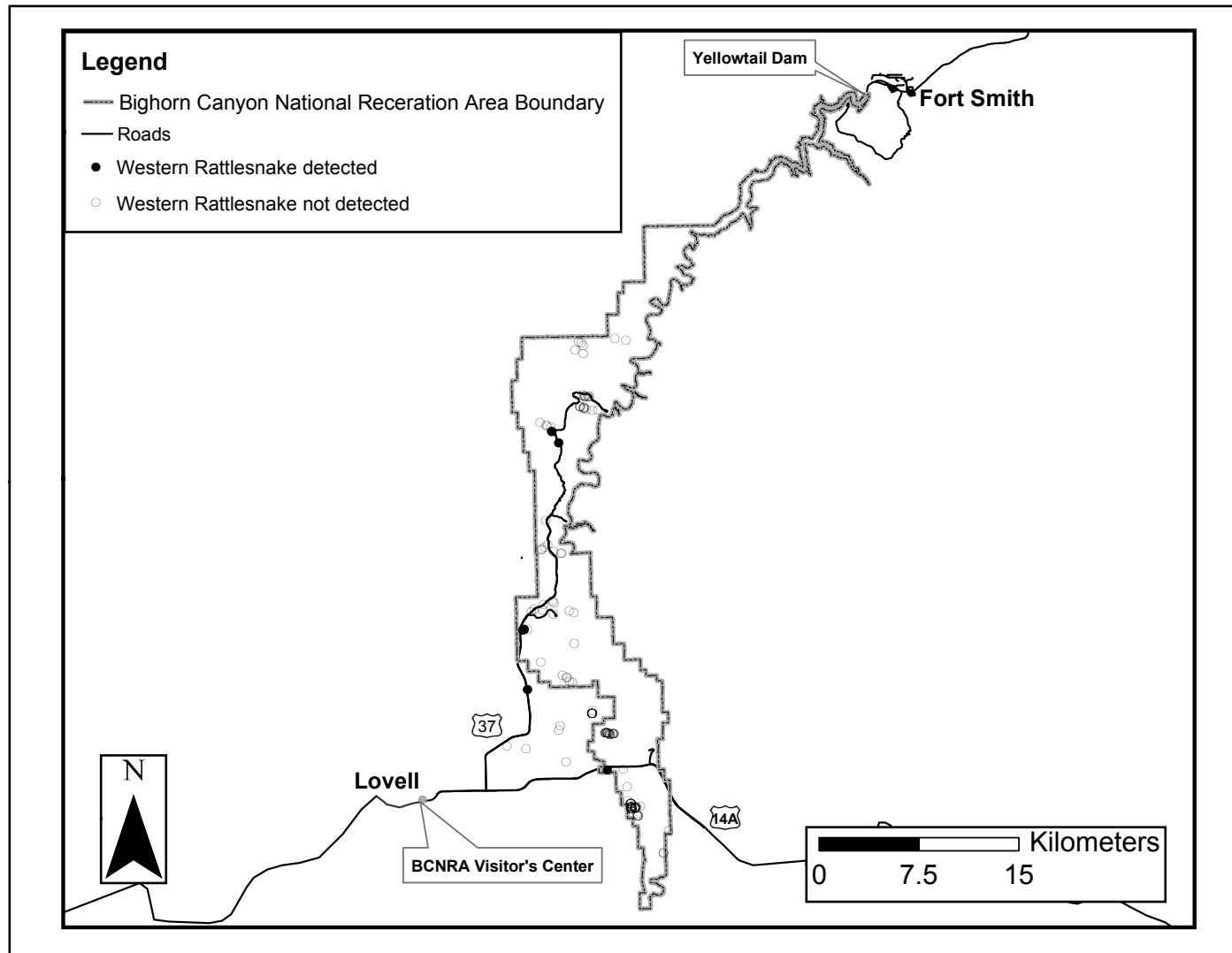


Figure 19. Western Rattlesnake dot distribution map.

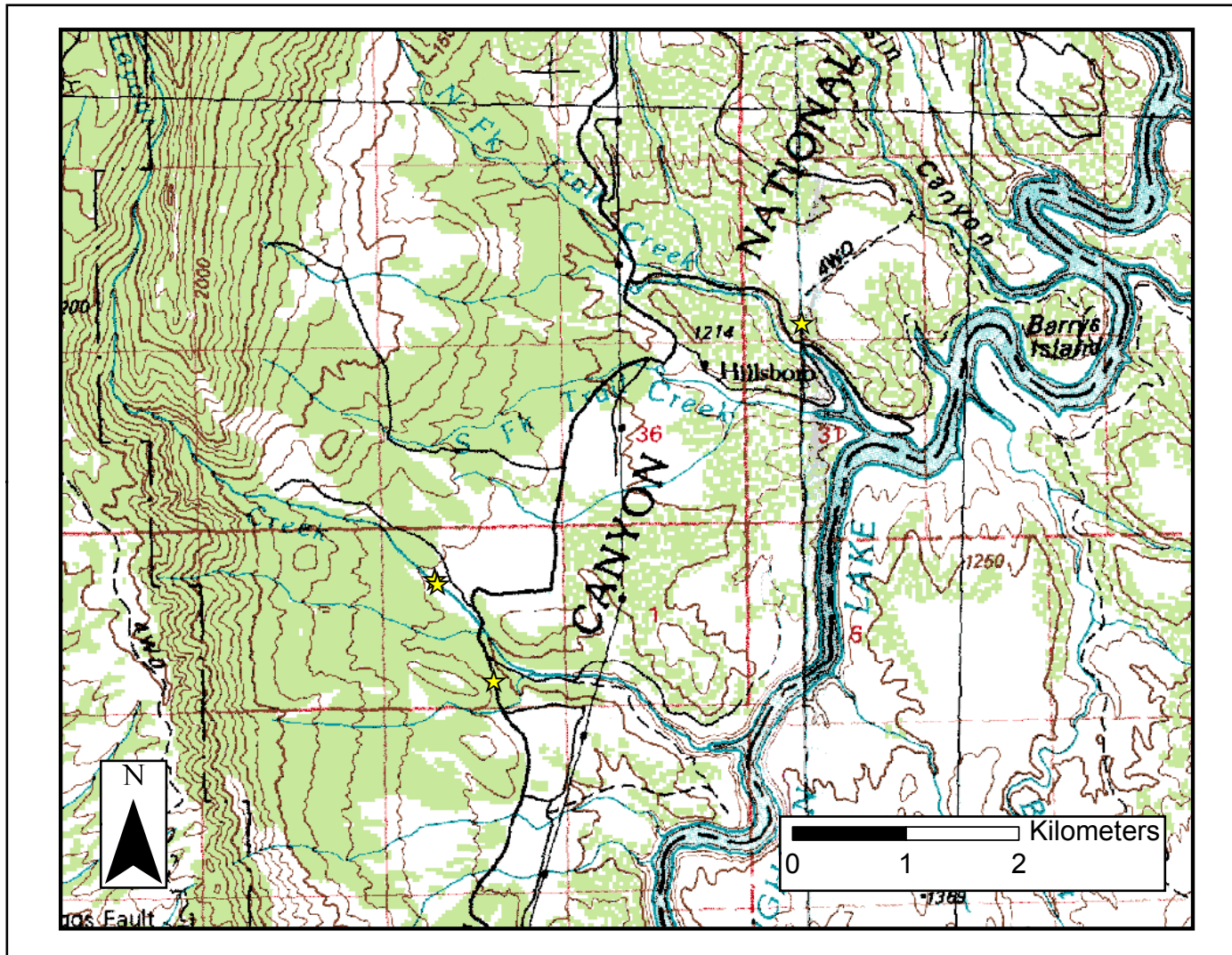


Figure 20a. Western Rattlesnake distribution. This area is located west of Barry's Landing and east of Hwy 37 and includes Hillsboro at the north end and Upper Layout Creek at the southwest end (Bridger Quadrangle, Mont. 100k series).

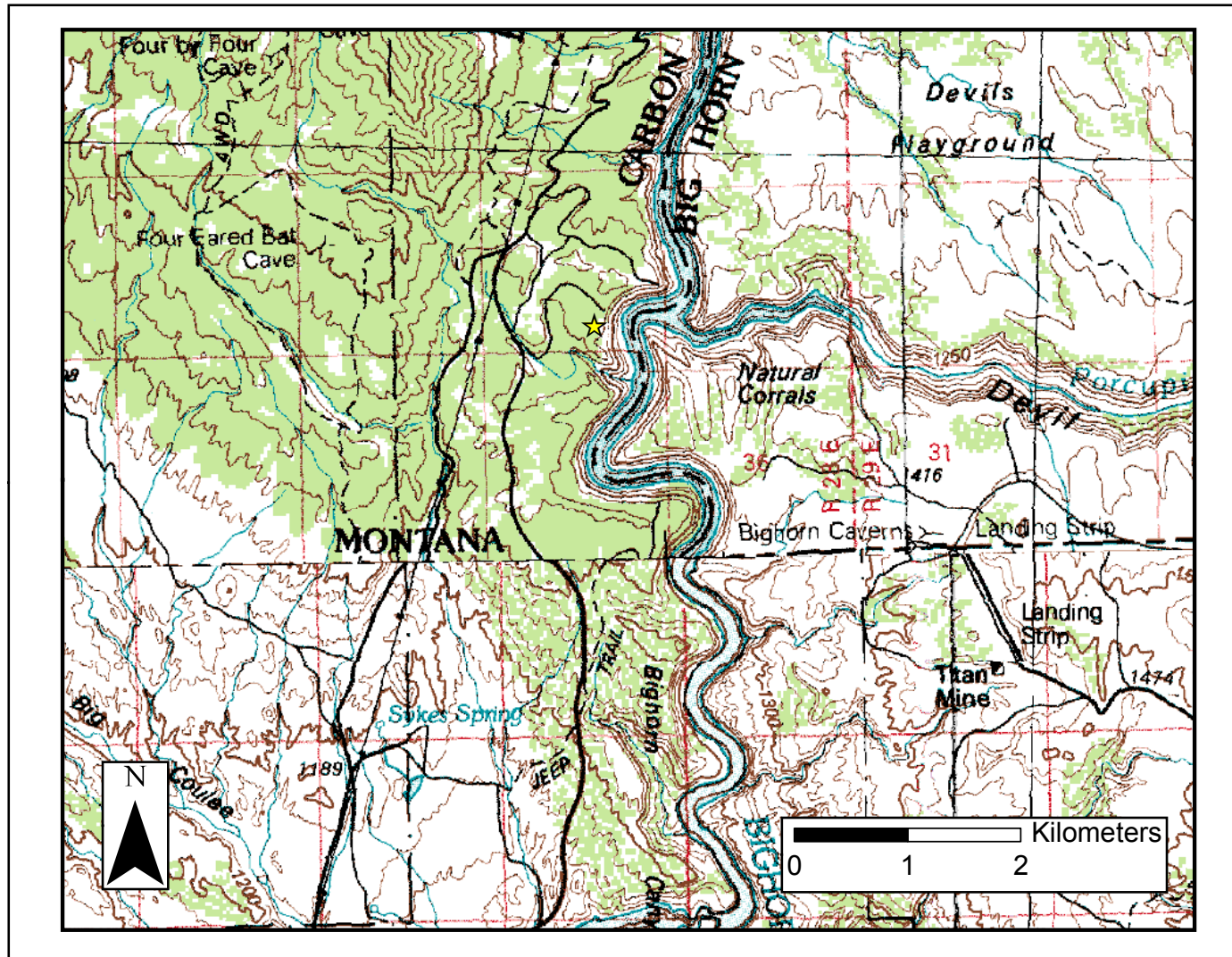


Figure 20b. Western Rattlesnake distribution. This area is located at the state line between Montana and Wyoming south of Devil's Canyon overlook (Bridger Quadrangle, Mont. 100k series).

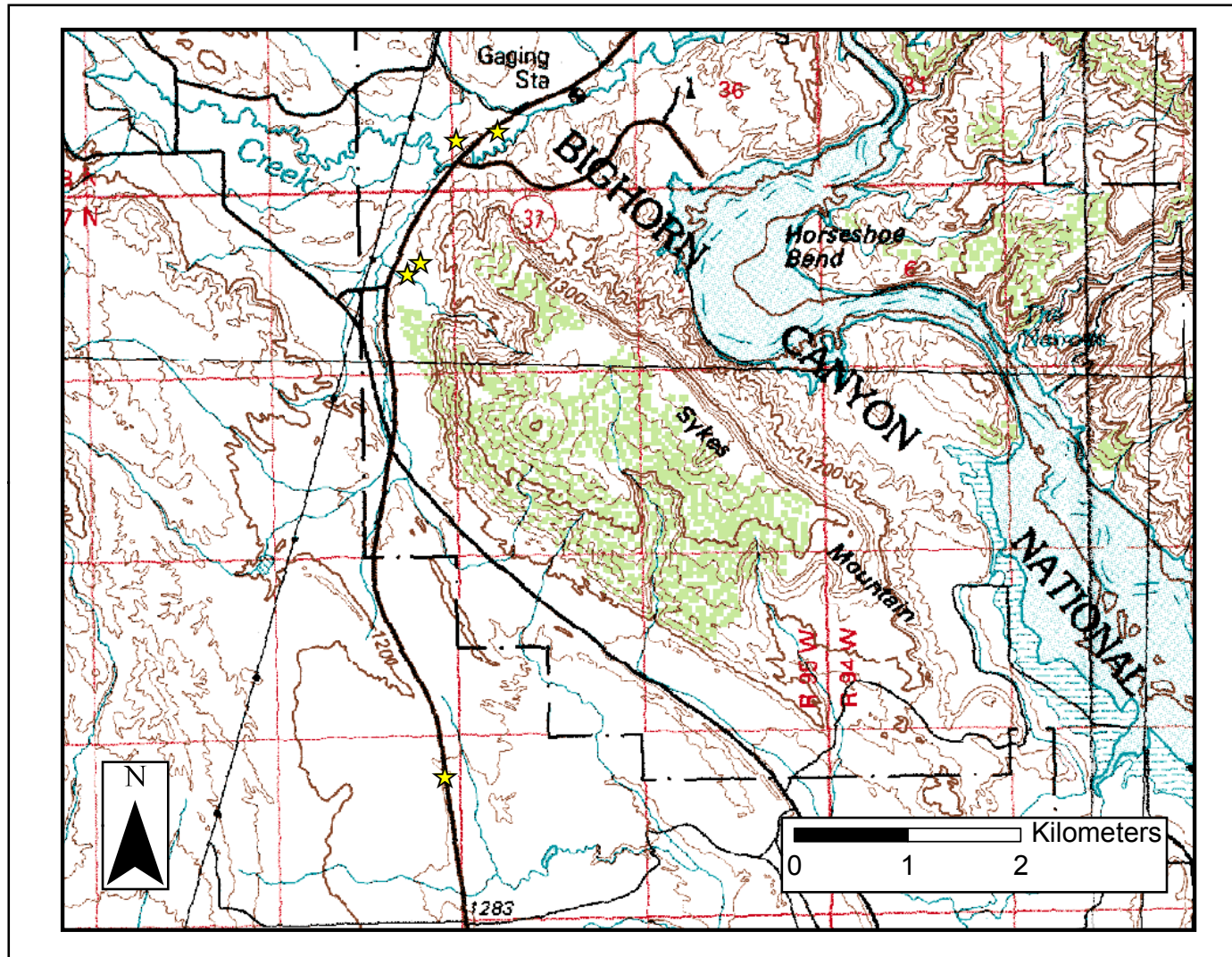


Figure 20c. Western Rattlesnake distribution. This area is located east of Hwy 37 and includes Sykes Mountain, Crooked Creek, and Horseshoe Bend (Powell Quadrangle, Wyo. 100k series).

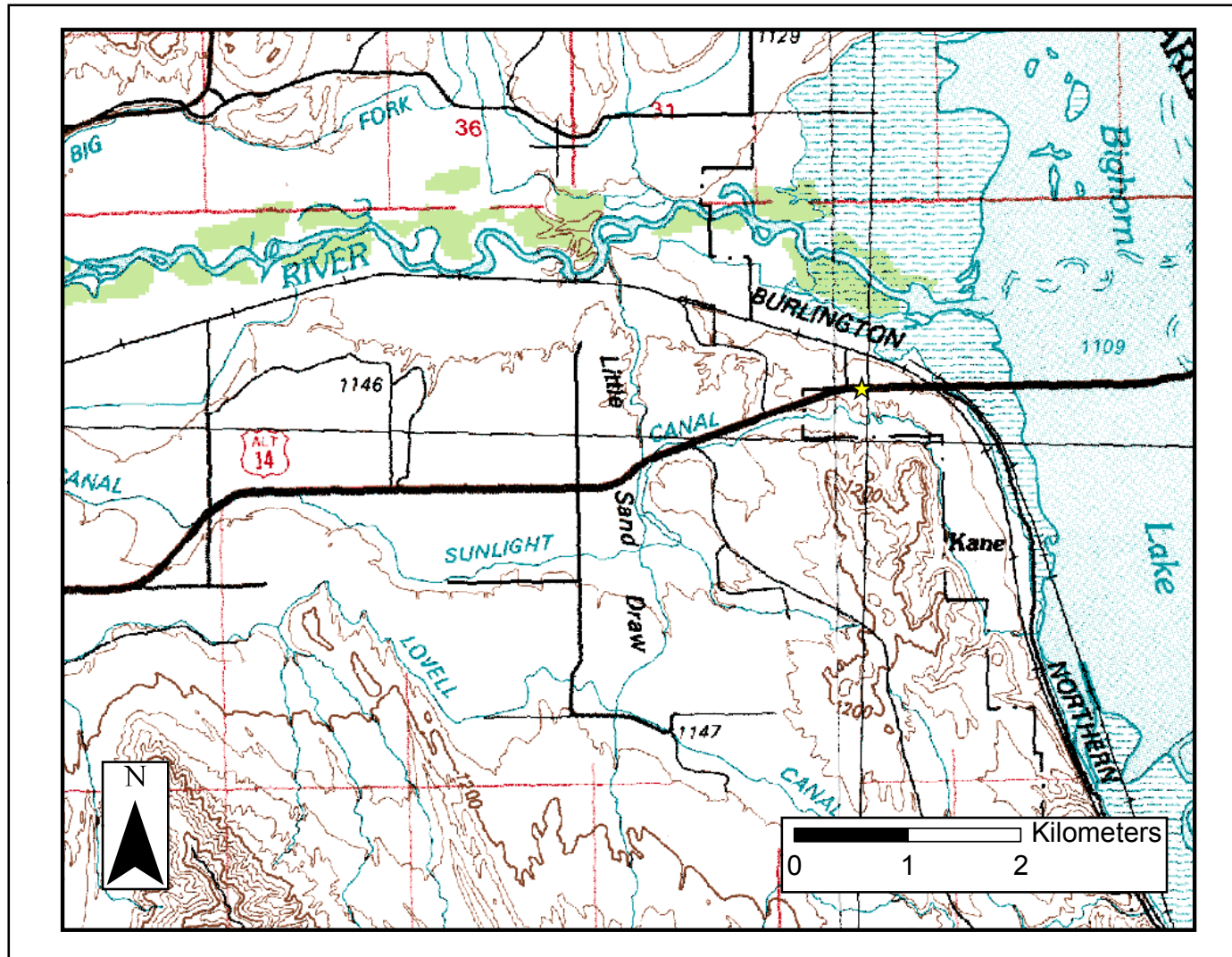


Figure 20d. Western Rattlesnake distribution. This area is located at the south end of Bighorn Canyon National Recreation Area (Powell Quadrangle, Wyo. 100k series).

Appendix A

Bighorn Canyon Habitat Classifications

(Adapted from Knight et al., 1987)

1. Wetland
2. Riparian vegetation
 - a. Floodplain meadow and mudflats
 - b. Floodplain shrubland
 - c. Floodplain woodland
 - d. Creek woodland
3. Desert shrubland
 - a. Saltbush
 - b. Sagebrush
 - c. Greasewood
 - d. Mixed desert
4. Sagebrush steppe
5. Grassland
 - a. Mixed-grass prairie
 - b. Basin grassland
 - c. Windswept plateau
6. Juniper/Mountain mahogany
 - a. Juniper woodland
 - b. Juniper/Mountain mahogany woodland
 - c. Mountain mahogany woodland
7. Coniferous woodland or forest
 - a. Limber pine
 - b. Douglas fir
 - c. Ponderosa pine
 - d. Spruce-fir
8. Disturbed/Barren
 - a. rock
 - b. unvegetated

Appendix B

Species Observation Data Tables

| | Date | Species | Time | Habitat | Observer(s) | Location |
|----|----------|---------|------|---------------------------|------------------------------------|--|
| 1 | 04-28-01 | PICA | N/A | Riparian vegetation | Baum, R. | Crooked Cr. area on Hwy 37 |
| 2 | 04-28-01 | PICA | N/A | Disturbed/Barren | Baum, R. | Hwy 37 0.1mi north of Horseshoe Bend (HB) turn |
| 3 | 04-29-01 | PICA | 1933 | Riparian vegetation | Baum, R. | Crooked Cr. area on Hwy 37 |
| 4 | 04-29-01 | SCGR | N/A | Disturbed/Barren | Baum, R. | Abercrombie (directly across bay from HB |
| 5 | 05-22-01 | RAPI | 1519 | Wetland | Baum, R. | ~20m from pond S/SW of Kane Cemetery Pond |
| 6 | 05-22-01 | THEL | 1805 | Riparian vegetation | Baum, R. | ~40m east of road in YWHMA, north of RR Pond |
| 7 | 05-23-01 | PICA | 1656 | Disturbed/Barren | Baum, R. | Road on west end of YWHMA south of Hwy 14A |
| 8 | 05-23-01 | RAPI | 1429 | Wetland | Baum, R. | South end of Pond 8 |
| 9 | 05-23-01 | SCGR | 1033 | Disturbed/Barren | Baum, R. | Road next to Pond 11 in YWHMA |
| 10 | 05-23-01 | SCGR | 1013 | Wetland | Baum, R. | SE end of Pond 11 in YWHMA |
| 11 | 05-23-01 | THEL | 1746 | Riparian vegetation | Baum, R. | ~0.1mi south of Crooked Cr. Bay on Hwy 37 |
| 12 | 05-24-01 | SCGR | 1014 | Disturbed/Barren | Baum, R. | 1mi south of Mason-Lovell Ranch |
| 13 | 05-24-01 | SCGR | 1213 | Sagebrush steppe | Baum, R. | Upper Layout Cr. NW of Ewing-Snell Ranch |
| 14 | 05-24-01 | SCGR | 1224 | Juniper/Mountain mahogany | Baum, R. | Upper Layout Cr. NW of Ewing-Snell Ranch |
| 15 | 05-24-01 | SCGR | 1232 | Juniper/Mountain mahogany | Baum, R. | Upper Layout Cr. NW of Ewing-Snell Ranch |
| 16 | 05-24-01 | SCGR | 1246 | Juniper/Mountain mahogany | Baum, R. | Upper Layout Cr. NW of Ewing-Snell Ranch |
| 17 | 05-25-01 | CRVI | 1038 | Desert shrubland | Baum, R., Peterson, C., Redder, A. | Flats southeast of Sykes Mtn |
| 18 | 05-25-01 | CRVI | 2255 | Disturbed/Barren | Baum, R., Peterson, C., Redder, A. | Hwy 37 |
| 19 | 05-25-01 | CRVI | N/A | Disturbed/Barren | Bredow, W. (NPS Ranger) | Intersection of Hillsboro road and Barry's Landing |
| 20 | 05-25-01 | PICA | 1450 | Riparian vegetation | Baum, R., Peterson, C., Redder, A. | Hillsboro |
| 21 | 05-25-01 | PICA | 1057 | Disturbed/Barren | Baum, R., Peterson, C., Redder, A. | Road past dump station before HB parking lot |
| 22 | 05-25-01 | SCGR | 1125 | Grassland | Baum, R., Peterson, C., Redder, A. | east of HB campground |
| 23 | 05-25-01 | SCGR | 1141 | Juniper/Mountain mahogany | Baum, R., Peterson, C., Redder, A. | east of HB campground |
| 24 | 05-25-01 | SCGR | 1524 | Disturbed/Barren | Baum, R., Peterson, C., Redder, A. | Hillsboro |
| 25 | 05-25-01 | SCGR | 1558 | Juniper/Mountain mahogany | Baum, R., Peterson, C., Redder, A. | Hillsboro |
| 26 | 05-25-01 | SCGR | 1432 | Disturbed/Barren | Baum, R., Peterson, C., Redder, A. | next cabin & road at Hillsboro |
| 27 | 05-25-01 | THEL | 1442 | Riparian vegetation | Baum, R., Peterson, C., Redder, A. | Hillsboro |
| 28 | 05-25-01 | THEL | 1454 | Riparian vegetation | Baum, R., Peterson, C., Redder, A. | Hillsboro |
| 29 | 05-25-01 | THEL | 1501 | Riparian vegetation | Baum, R., Peterson, C., Redder, A. | Hillsboro |
| 30 | 05-26-01 | CRVI | 1528 | Disturbed/Barren | Baum, R., Peterson, C., Redder, A. | Hwy 14A |
| 31 | 05-26-01 | THEL | 1014 | Riparian vegetation | Baum, R., Peterson, C., Redder, A. | Crooked Creek |
| 32 | 05-26-01 | THEL | 1118 | Riparian vegetation | Baum, R., Peterson, C., Redder, A. | Crooked Creek |
| 33 | 05-29-01 | PICA | 1826 | Disturbed/Barren | Baum, R. | Hwy 14A |
| 34 | 05-30-01 | THEL | 1817 | Disturbed/Barren | Baum, R. | Brick house (old Game Fish & Park residence) |
| 35 | 05-30-01 | THEL | 1724 | Disturbed/Barren | Baum, R. | southwest end of Pond 2 |
| 36 | 06-01-01 | SCGR | 1007 | Disturbed/Barren | Baum, R. | Lockhart ranch |
| 37 | 06-01-01 | SCGR | 1037 | Disturbed/Barren | Baum, R. | Wassin Canyon east of Lockhart ranch |
| 38 | 06-02-01 | PICA | N/A | Disturbed/Barren | Park personnel | Intersection of hwy 37 and Horseshoe Bend road |
| 39 | 06-02-01 | SCGR | 0939 | Juniper/Mountain mahogany | Baum, R. | Off road to Hillsboro |
| 40 | 06-05-01 | PICA | 1259 | Disturbed/Barren | Baum, R. | Roadkill on Barry's Landing road |
| 41 | 06-06-01 | CRVI | 1735 | Desert shrubland | Baum, R. | flats west of Sykes mountain |
| 42 | 06-06-01 | SCGR | 1752 | Desert shrubland | Baum, R. | flats west of Sykes mountain |
| 43 | 06-07-01 | SCGR | 1057 | Disturbed/Barren | Baum, R. | Canyon north of Lockhart Ranch |
| 44 | 06-07-01 | SCGR | 1112 | Disturbed/Barren | Baum, R. | Canyon north of Lockhart Ranch |
| 45 | 06-07-01 | SCGR | 1123 | Juniper/Mountain mahogany | Baum, R. | Canyon north of Lockhart Ranch |
| 46 | 06-07-01 | SCGR | 1735 | Desert shrubland | Baum, R. | south side of Sykes mtn. |
| 47 | 06-08-01 | SCGR | 0945 | Disturbed/Barren | Baum, R. | southeast side of Sykes mtn. |
| 48 | 06-08-01 | SCGR | 1013 | Disturbed/Barren | Baum, R. | southeast side of Sykes mtn. |
| 49 | 06-08-01 | SCGR | 1016 | Disturbed/Barren | Baum, R. | southeast side of Sykes mtn. |

| | Comments | CC | Rad | Wind | Temp | UTM zone | Easting | Northing | Elev (m) | Accuracy (m) | State | County | Survey Method |
|----|--|-----|---------|------------|--------|----------|---------|----------|----------|--------------|-------|---------|---------------|
| 1 | Trimble file R042821B, creek woodland | | | | n/a | 12N | 0714290 | 4982417 | n/a | +/- 10 | WY | Bighorn | RC |
| 2 | Trimble file R042821A, roadkill hwy 37 | | | | n/a | 12N | 0714067 | 4982184 | n/a | +/- 10 | WY | Bighorn | RC |
| 3 | Roadkill Trimble R043001A, creek woodland | | | | n/a | 12N | 0714948 | 4982726 | n/a | +/- 10 | WY | Bighorn | RC |
| 4 | Trimble file R042920A, Chugwater rock fissures | 30% | clear | calm | N/A | 12N | 0717307 | 4979870 | n/a | +/- 10 | WY | Bighorn | VES |
| 5 | digital photos, wet meadow with grass/sedges | 25% | clear | moder | 25 C | 12N | 0719754 | 4973220 | 1123 | +/- 10 | WY | Bighorn | VES |
| 6 | adult, no capture, floodplain shrubland | 65% | partial | light-mod | 25 C | 12N | 0721486 | 4969194 | 1122 | +/- 10 | WY | Bighorn | Opp Obs |
| 7 | no capt, dps, ~1m in length on road | 20% | clear | light | 29 C | 12N | 0721516 | 4968126 | 1123 | +/- 10 | WY | Bighorn | RC |
| 8 | no capture, dps, in emergent veg (sedges) at pond edge | 10% | clear | high | 28 C | 12N | 0722114 | 4967578 | 1117 | +/- 10 | WY | Bighorn | VES |
| 9 | no capture, dps, rocky area next to road | 0% | clear | calm-light | 24 C | 12N | 0724316 | 4964221 | 1122 | +/- 10 | WY | Bighorn | VES |
| 10 | no capture, mixed grass/sedge ~30m to pond | 0% | clear | calm-light | 24 C | 12N | 0724290 | 4964221 | 1119 | +/- 10 | WY | Bighorn | VES |
| 11 | Roadkill on hwy 37 in creek woodland | | | | n/a | 12N | 0715641 | 4983070 | 1125 | +/- 10 | WY | Bighorn | RC |
| 12 | on road | | | | n/a | 12N | 0724636 | 4965935 | 1140 | +/- 10 | WY | Bighorn | RC |
| 13 | | 0% | clear | light | 78.4 F | 12N | 0715281 | 4996104 | 1312 | +/- 10 | MT | Carbon | VES |
| 14 | sgbr/juniper woodland, dps | 0% | clear | light | 78.4 F | 12N | 0714967 | 4996199 | 1352 | +/- 10 | MT | Carbon | VES |
| 15 | sgbr/juniper woodland | 0% | clear | light | 78.4 F | 12N | 0714911 | 4996254 | 1345 | +/- 10 | MT | Carbon | VES |
| 16 | sgbr/juniper woodland | 0% | clear | light | 78.4 F | 12N | 0714435 | 4996436 | 1386 | +/- 10 | MT | Carbon | VES |
| 17 | voucher 1, dps, roadkill on hwy 37 | | | | n/a | 12N | 0713864 | 4976374 | 1189 | +/- 10 | WY | Bighorn | RC |
| 18 | roadkill, taken for voucher2 | | | | 20.8 C | 12N | 0715870 | 4994905 | 1293 | +/- 10 | MT | Carbon | RC |
| 19 | found dead that morning | | | | n/a | 12N | 0718532 | 4998116 | n/a | +/- 10 | WY | Bighorn | Contr obs |
| 20 | dps, cattails/marsh edge, no capture | 15% | clear | light | 29 C | 12N | 0717708 | 4997593 | 1183 | +/- 10 | MT | Carbon | VES |
| 21 | roadkill, dps, basin grassland | | | | n/a | 12N | 0715735 | 4982073 | 1131 | +/- 10 | WY | Bighorn | RC |
| 22 | dps, basin grassland | 10% | clear | calm | n/a | 12N | 0716910 | 4982365 | 1216 | +/- 10 | WY | Bighorn | VES |
| 23 | dps, juniper woodland with rocky outcrops | 10% | clear | calm | n/a | 12N | 0717233 | 4982199 | 1173 | +/- 10 | WY | Bighorn | VES |
| 24 | dps, rocky outcrop | 15% | clear | light | 29 C | 12N | 0717458 | 4997705 | 1214 | +/- 10 | MT | Carbon | VES |
| 25 | | 15% | clear | light | 29 C | 12N | 0717893 | 4997506 | 1169 | +/- 10 | MT | Carbon | VES |
| 26 | dps, at edge of juniper wdland and riparian veg | 15% | clear | light | 29 C | 12N | 0718795 | 4997415 | 1147 | +/- 10 | MT | Carbon | VES |
| 27 | dps, next to stream, female, svl: 36cm, tl: 11cm | 15% | clear | light | 29 C | 12N | 0717767 | 4997546 | 1173 | +/- 10 | MT | Carbon | VES |
| 28 | dps, cattails/marsh edge, male, svl: 43.5 cm, tl: 11cm | 15% | clear | light | 29 C | 12N | 0717726 | 4997582 | 1179 | +/- 10 | MT | Carbon | VES |
| 29 | dps, cattails/marsh edge, no capture | 15% | clear | light | 29 C | 12N | 0717719 | 4997592 | 1180 | +/- 10 | MT | Carbon | VES |
| 30 | dps, roadkill near desert shrubland | 10% | clear | light | 26.2 C | 12N | 0719969 | 4970455 | 1134 | +/- 10 | WY | Bighorn | RC |
| 31 | dps, next to streambank, female, no measurements | 5% | clear | light | 21.9 C | 12N | 0715742 | 4982916 | 1116 | +/- 10 | WY | Bighorn | VES |
| 32 | dps, sandy stream bank next to grass, no capture | 10% | clear | light | 26.6 C | 12N | 0714916 | 4982381 | 1123 | +/- 10 | WY | Bighorn | VES |
| 33 | dps, roadkill near riparian vegetation (floodplain meadow) | 60% | partial | moder | 26.8 C | 12N | 0721155 | 4970495 | 1122 | +/- 10 | WY | Bighorn | RC |
| 34 | front basement window sill | 40% | partial | calm | 22.6 C | 12N | 0712420 | 4972101 | 1150 | +/- 10 | WY | Bighorn | Opp Obs |
| 35 | dps, edge of riparian veg (floodplain shrubland) and road | 30% | partial | light | 25.4 C | 12N | 0713848 | 4971901 | 1143 | +/- 10 | WY | Bighorn | VES |
| 36 | dps, edge of road and sagebrush area (Creek woodland) | 5% | clear | calm | 22.4 C | 12N | 0716989 | 5001918 | 1327 | +/- 10 | MT | Carbon | VES |
| 37 | dps, rocky unvegetated area | 0% | clear | calm | 23.6 C | 12N | 0717580 | 5001692 | 1333 | +/- 10 | MT | Carbon | VES |
| 38 | UTM taken after description of obs. location from park pers. | | | | n/a | 12N | 0713916 | 4981786 | 1144 | +/- 30 | WY | Bighorn | Contr obs |
| 39 | dps, rocky area in juniper woodland | | | | n/a | 12N | 0718370 | 4997448 | n/a | +/- 10 | WY | Bighorn | Opp Obs |
| 40 | dps, near riparian habitat (creek woodlnd) | 70% | partial | light | 21.6 C | 12N | 0718147 | 4998415 | 1160 | +/- 10 | MT | Carbon | RC |
| 41 | dps, found at burrow entrance in saltbush shrblind | 20% | clear | light | 23.8 C | 12N | 0713456 | 4980800 | 1172 | +/- 10 | WY | Bighorn | VES |
| 42 | dps, rocky area in mixed desert shrblind | 20% | clear | light | 23.8 C | 12N | 0713798 | 4980847 | 1197 | +/- 10 | WY | Bighorn | VES |
| 43 | dps, rocky habitat near juniper woodlnd | 10% | clear | light | 22.8 C | 12N | 0717219 | 5002538 | 1352 | +/- 10 | MT | Carbon | VES |
| 44 | dps, rocky habitat near juniper woodlnd | 10% | clear | light | 22.8 C | 12N | 0717430 | 5002441 | 1346 | +/- 10 | MT | Carbon | VES |
| 45 | dps | 10% | clear | light | 22.8 C | 12N | 0717592 | 5002262 | 1354 | +/- 10 | MT | Carbon | VES |
| 46 | dps, mixed desert shrblind with barren (rocky) area nearby | 50% | clear | light | 29.2 C | 12N | 0714833 | 4978448 | 1224 | +/- 10 | WY | Bighorn | VES |
| 47 | dps, rocky area near desert shrblind | 0% | clear | light | 24.2 C | 12N | 0717230 | 4976928 | 1174 | +/- 10 | WY | Bighorn | VES |
| 48 | dps rocky area near desert shrblind | 0% | clear | light | 24.2 C | 12N | 0716851 | 4977293 | 1203 | +/- 10 | WY | Bighorn | VES |
| 49 | dps, rocky area near desert shrblind | 0% | clear | light | 24.2 C | 12N | 0716816 | 4977335 | 1211 | +/- 10 | WY | Bighorn | VES |

| | Date | Species | Time | Habitat | Observer(s) | Location |
|----|----------|---------|------|---------------------------|-----------------------|--|
| 50 | 06-08-01 | SCGR | 1033 | Disturbed/Barren | Baum, R. | southeast side of Sykes mtn. |
| 51 | 06-08-01 | SCGR | 1059 | Desert shrubland | Baum, R. | southeast side of Sykes mtn. |
| 52 | 06-15-01 | PHDO | N/A | N/A | Roser, J. (USGS crew) | N/A |
| 53 | 06-15-01 | PHDO | N/A | N/A | Roser, J. (USGS crew) | N/A |
| 54 | 06-15-01 | PHDO | N/A | Sagebrush steppe | Roser, J. (USGS crew) | N/A |
| 55 | 06-15-01 | PHDO | N/A | Sagebrush steppe | Roser, J. (USGS crew) | N/A |
| 56 | 06-16-01 | PHDO | N/A | N/A | Roser, J. (USGS crew) | west of Big Coulee |
| 57 | 06-18-01 | SCGR | N/A | Disturbed/Barren | Roser, J. (USGS crew) | N/A |
| 58 | 06-18-01 | SCGR | N/A | Juniper/Mountain mahogany | Roser, J. (USGS crew) | N/A |
| 59 | 07-05-01 | PHDO | N/A | Sagebrush steppe | Roser, J. (USGS crew) | Crooked Cr. |
| 60 | 07-05-01 | SCGR | 1033 | Juniper/Mountain mahogany | Baum, R. | Annerer Spring area near Pete's Canyon |
| 61 | 07-05-01 | SCGR | N/A | Sagebrush steppe | Roser, J. (USGS crew) | Crooked Cr. |
| 62 | 07-05-01 | SCGR | 1343 | Juniper/Mountain mahogany | Baum, R. | hillside north of Barry's Landing road |
| 63 | 07-05-01 | SCGR | 1355 | Juniper/Mountain mahogany | Baum, R. | hillside north of Barry's Landing road |
| 64 | 07-05-01 | SCGR | 1402 | Disturbed/Barren | Baum, R. | hillside north of Barry's Landing road |
| 65 | 07-05-01 | SCGR | 1409 | Juniper/Mountain mahogany | Baum, R. | hillside north of Barry's Landing road |
| 66 | 07-05-01 | SCGR | 1416 | Juniper/Mountain mahogany | Baum, R. | hillside north of Barry's Landing road |
| 67 | 07-05-01 | SCGR | 1420 | Juniper/Mountain mahogany | Baum, R. | hillside north of Barry's Landing road |
| 68 | 07-05-01 | SCGR | 1430 | Juniper/Mountain mahogany | Baum, R. | hillside north of Barry's Landing road |
| 69 | 07-05-01 | SCGR | 1102 | Juniper/Mountain mahogany | Baum, R. | Pete's Canyon |
| 70 | 07-09-01 | PHDO | N/A | N/A | Roser, J. (USGS crew) | Crooked Cr. |
| 71 | 07-12-01 | PHDO | N/A | Sagebrush steppe | Roser, J. (USGS crew) | Sykes fingers (west face) |
| 72 | 07-14-01 | PHDO | N/A | Juniper/Mountain mahogany | Roser, J. (USGS crew) | Sykes fingers (west face) |
| 73 | 07-16-01 | BUWO | 1020 | Wetland | Baum, R. | Kane Cemetery pond |
| 74 | 07-16-01 | BUWO | 1113 | Wetland | Baum, R. | Kane Cemetery pond |
| 75 | 07-16-01 | BUWO | 1357 | Wetland | Baum, R. | Pond 6 |
| 76 | 07-16-01 | BUWO | 1416 | Wetland | Baum, R. | Pond 6 |
| 77 | 07-16-01 | BUWO | 1416 | Wetland | Baum, R. | Pond 6 |
| 78 | 07-16-01 | BUWO | 1416 | Wetland | Baum, R. | Pond 6 |
| 79 | 07-16-01 | BUWO | 1416 | Wetland | Baum, R. | Pond 6 |
| 80 | 07-16-01 | BUWO | 1416 | Wetland | Baum, R. | Pond 6 |
| 81 | 07-16-01 | BUWO | 1416 | Wetland | Baum, R. | Pond 6 |
| 82 | 07-16-01 | BUWO | 1416 | Wetland | Baum, R. | Pond 6 |
| 83 | 07-16-01 | BUWO | 1416 | Wetland | Baum, R. | Pond 6 |
| 84 | 07-16-01 | BUWO | 1418 | Wetland | Baum, R. | Pond 6 |
| 85 | 07-16-01 | BUWO | 1418 | Wetland | Baum, R. | Pond 6 |
| 86 | 07-16-01 | BUWO | 1418 | Wetland | Baum, R. | Pond 6 |
| 87 | 07-16-01 | BUWO | 1418 | Wetland | Baum, R. | Pond 6 |
| 88 | 07-16-01 | BUWO | 1418 | Wetland | Baum, R. | Pond 6 |
| 89 | 07-16-01 | BUWO | 1418 | Wetland | Baum, R. | Pond 6 |
| 90 | 07-16-01 | RAPI | 0956 | Wetland | Baum, R. | Kane Cemetery pond |
| 91 | 07-16-01 | RAPI | 0957 | Wetland | Baum, R. | Kane Cemetery pond |
| 92 | 07-16-01 | RAPI | 1007 | Wetland | Baum, R. | Kane Cemetery pond |
| 93 | 07-16-01 | RAPI | 1030 | Wetland | Baum, R. | Kane Cemetery pond |
| 94 | 07-16-01 | RAPI | 1036 | Wetland | Baum, R. | Kane Cemetery pond |
| 95 | 07-16-01 | RAPI | 1043 | Wetland | Baum, R. | Kane Cemetery pond |
| 96 | 07-16-01 | RAPI | 1043 | Wetland | Baum, R. | Kane Cemetery pond |
| 97 | 07-16-01 | RAPI | 1052 | Wetland | Baum, R. | Kane Cemetery pond |
| 98 | 07-16-01 | RAPI | 1100 | Wetland | Baum, R. | Kane Cemetery pond |
| 99 | 07-16-01 | RAPI | 1104 | Wetland | Baum, R. | Kane Cemetery pond |

| | Comments | CC | Rad | Wind | Temp | UTM | Easting | Northing | Elev (m) | Accuracy (m) | State | County | Survey Method |
|----|---|-----|---------|-------|--------|-----|---------|----------|----------|--------------|-------|---------|---------------|
| 50 | dps, rocky area near desert shrblnd | 0% | clear | light | 24.2 C | 12N | 0716472 | 4977482 | 1244 | +/- 10 | WY | Bighorn | VES |
| 51 | dps, mixed desrt shrblnd near rocky area | 0% | clear | light | 24.2 C | 12N | 0717022 | 4977040 | 1242 | +/- 10 | WY | Bighorn | VES |
| 52 | | | | | n/a | 12N | 0709172 | 4991657 | n/a | +/- 10 | MT | Carbon | Contr obs |
| 53 | | | | | n/a | 12N | 0709551 | 4994041 | n/a | +/- 10 | MT | Carbon | Contr obs |
| 54 | | | | | n/a | 12N | 0708973 | 4991712 | n/a | +/- 10 | MT | Carbon | Contr obs |
| 55 | | | | | n/a | 12N | 0709538 | 4993858 | n/a | +/- 10 | MT | Carbon | Contr obs |
| 56 | | | | | n/a | 12N | 0710200 | 4992982 | n/a | +/- 10 | MT | Carbon | Contr obs |
| 57 | | | | | n/a | 12N | 0709100 | 4990250 | n/a | +/- 10 | MT | Carbon | Contr obs |
| 58 | | | | | n/a | 12N | 0709567 | 4989970 | n/a | +/- 10 | MT | Carbon | Contr obs |
| 59 | 2 lizards observed | | | | n/a | 12N | 0704889 | 4993248 | n/a | +/- 10 | MT | Carbon | Contr obs |
| 60 | dps, jun/mtn. mah wdln | 60% | partial | light | 15.4 C | 12N | 0719929 | 5002845 | 1339 | +/- 10 | MT | Carbon | VES |
| 61 | | | | | n/a | 12N | 0704159 | 4991758 | n/a | +/- 10 | MT | Carbon | Contr obs |
| 62 | dps, rocky area in juniper woodland | 70% | partial | light | 21.6 C | 12N | 0718086 | 4998474 | 1172 | +/- 10 | MT | Carbon | VES |
| 63 | dps, rocky area in juniper woodland, near riparian area | 70% | partial | light | 21.6 C | 12N | 0718016 | 4998452 | 1173 | +/- 10 | MT | Carbon | VES |
| 64 | dps, rocky unvegetated area near riparian woodln | 70% | partial | light | 21.6 C | 12N | 0717824 | 4998464 | 1174 | +/- 10 | MT | Carbon | VES |
| 65 | dps, juniper woodln | 70% | partial | light | 21.6 C | 12N | 0717787 | 4998483 | 1181 | +/- 10 | MT | Carbon | VES |
| 66 | dps, juniper woodln | 70% | partial | light | 21.6 C | 12N | 0717761 | 4998458 | 1185 | +/- 10 | MT | Carbon | VES |
| 67 | dps, juniper woodln | 70% | partial | light | 21.6 C | 12N | 0717746 | 4998468 | 1197 | +/- 10 | MT | Carbon | VES |
| 68 | dps, juniper woodln | 70% | partial | light | 21.6 C | 12N | 0717582 | 4998537 | 1200 | +/- 10 | MT | Carbon | VES |
| 69 | dps, jun/mtn. mah wdln | 60% | partial | light | 15.4 C | 12N | 0720754 | 5002711 | 1357 | +/- 10 | MT | Carbon | VES |
| 70 | | | | | n/a | 12N | 0703931 | 4993248 | n/a | +/- 10 | MT | Carbon | Contr obs |
| 71 | | | | | n/a | 12N | 0712705 | 4994825 | n/a | +/- 10 | MT | Carbon | Contr obs |
| 72 | | | | | n/a | 12N | 0713090 | 4990640 | n/a | +/- 10 | MT | Carbon | Contr obs |
| 73 | juv. (3.8 cm SVL), dp | 5% | clear | calm | 23.8 C | 12N | 0720326 | 4973130 | 1125 | +/- 10 | WY | Bighorn | VES |
| 74 | juv., (2.4 cm SVL), SW end of main pond | 5% | clear | calm | 23.8 C | 12N | 0719858 | 4973196 | 1115 | +/- 10 | WY | Bighorn | VES |
| 75 | juv. (1.6 cm SVL), NW end in shallows, dp | 20% | clear | calm | 30.6 C | 12N | 0718777 | 4974838 | 1131 | +/- 10 | WY | Bighorn | VES |
| 76 | juv., NW end in shallows, dp | 20% | clear | calm | 30.6 C | 12N | 0718765 | 4974671 | 1130 | +/- 10 | WY | Bighorn | VES |
| 77 | juv., NW end in shallows, dp | 20% | clear | calm | 30.6 C | 12N | 0718765 | 4974671 | 1130 | +/- 10 | WY | Bighorn | VES |
| 78 | juv., NW end in shallows, dp | 20% | clear | calm | 30.6 C | 12N | 0718765 | 4974671 | 1130 | +/- 10 | WY | Bighorn | VES |
| 79 | juv., NW end in shallows, dp | 20% | clear | calm | 30.6 C | 12N | 0718765 | 4974671 | 1130 | +/- 10 | WY | Bighorn | VES |
| 80 | juv., NW end in shallows, dp | 20% | clear | calm | 30.6 C | 12N | 0718765 | 4974671 | 1130 | +/- 10 | WY | Bighorn | VES |
| 81 | juv., NW end in shallows, dp | 20% | clear | calm | 30.6 C | 12N | 0718765 | 4974671 | 1130 | +/- 10 | WY | Bighorn | VES |
| 82 | juv., NW end in shallows, dp | 20% | clear | calm | 30.6 C | 12N | 0718765 | 4974671 | 1130 | +/- 10 | WY | Bighorn | VES |
| 83 | juv., NW end in shallows, dp | 20% | clear | calm | 30.6 C | 12N | 0718765 | 4974671 | 1130 | +/- 10 | WY | Bighorn | VES |
| 84 | juv., NW end in shallows, dp | 20% | clear | calm | 30.6 C | 12N | 0718763 | 4974669 | 1130 | +/- 10 | WY | Bighorn | VES |
| 85 | juv., NW end in shallows, dp | 20% | clear | calm | 30.6 C | 12N | 0718763 | 4974669 | 1130 | +/- 10 | WY | Bighorn | VES |
| 86 | juv., NW end in shallows, dp | 20% | clear | calm | 30.6 C | 12N | 0718763 | 4974669 | 1130 | +/- 10 | WY | Bighorn | VES |
| 87 | juv., NW end in shallows, dp | 20% | clear | calm | 30.6 C | 12N | 0718763 | 4974669 | 1130 | +/- 10 | WY | Bighorn | VES |
| 88 | juv., NW end in shallows, dp | 20% | clear | calm | 30.6 C | 12N | 0718763 | 4974669 | 1130 | +/- 10 | WY | Bighorn | VES |
| 89 | juv., NW end in shallows, dp | 20% | clear | calm | 30.6 C | 12N | 0718765 | 4974671 | 1130 | +/- 10 | WY | Bighorn | VES |
| 90 | juv., no capture, NE end of south ponds | 5% | clear | calm | 23.8 C | 12N | 0720414 | 4973133 | 1124 | +/- 10 | WY | Bighorn | VES |
| 91 | juv., no capture, NE end of south ponds | 5% | clear | calm | 23.8 C | 12N | 0720414 | 4973133 | 1125 | +/- 10 | WY | Bighorn | VES |
| 92 | juv. (4.4 cm SVL), NE end of south ponds, dp | 5% | clear | calm | 23.8 C | 12N | 0720423 | 4973133 | 1123 | +/- 10 | WY | Bighorn | VES |
| 93 | juv., unable to capture | 5% | clear | calm | 23.8 C | 12N | 0720328 | 4973129 | 1125 | +/- 10 | WY | Bighorn | VES |
| 94 | juv., unable to capture | 5% | clear | calm | 23.8 C | 12N | 0720276 | 4973125 | 1125 | +/- 10 | WY | Bighorn | VES |
| 95 | juv., no capture, SW end of main pond | 5% | clear | calm | 23.8 C | 12N | 0720070 | 4973133 | 1113 | +/- 10 | WY | Bighorn | VES |
| 96 | juv., no capture, SW end of main pond | 5% | clear | calm | 23.8 C | 12N | 0720070 | 4973133 | 1113 | +/- 10 | WY | Bighorn | VES |
| 97 | juv., no capture, SW end of main pond | 5% | clear | calm | 23.8 C | 12N | 0720005 | 4973166 | 1118 | +/- 10 | WY | Bighorn | VES |
| 98 | juv., no capture, SW end of main pond | 5% | clear | calm | 23.8 C | 12N | 0719948 | 4973197 | 1118 | +/- 10 | WY | Bighorn | VES |
| 99 | juv., no capture, SW end of main pond | 5% | clear | calm | 23.8 C | 12N | 0719936 | 4973184 | 1115 | +/- 10 | WY | Bighorn | VES |

| | Date | Species | Time | Habitat | Observer(s) | Location |
|-----|----------|---------|------|---------|-------------|--------------------|
| 100 | 07-16-01 | RAPI | 1104 | Wetland | Baum, R. | Kane Cemetery pond |
| 101 | 07-16-01 | RAPI | 1109 | Wetland | Baum, R. | Kane Cemetery pond |
| 102 | 07-16-01 | RAPI | 1114 | Wetland | Baum, R. | Kane Cemetery pond |
| 103 | 07-16-01 | RAPI | 1120 | Wetland | Baum, R. | Kane Cemetery pond |
| 104 | 07-16-01 | RAPI | 1120 | Wetland | Baum, R. | Kane Cemetery pond |
| 105 | 07-16-01 | RAPI | 1120 | Wetland | Baum, R. | Kane Cemetery pond |
| 106 | 07-16-01 | RAPI | 1140 | Wetland | Baum, R. | Kane Cemetery pond |
| 107 | 07-16-01 | RAPI | 1140 | Wetland | Baum, R. | Kane Cemetery pond |
| 108 | 07-16-01 | RAPI | 1140 | Wetland | Baum, R. | Kane Cemetery pond |
| 109 | 07-17-01 | BUWO | 1540 | Wetland | Baum, R. | Pond 5 |
| 110 | 07-17-01 | BUWO | 1051 | Wetland | Baum, R. | Pond 6 1/2 |
| 111 | 07-17-01 | BUWO | 1051 | Wetland | Baum, R. | Pond 6 1/2 |
| 112 | 07-17-01 | BUWO | 1051 | Wetland | Baum, R. | Pond 6 1/2 |
| 113 | 07-17-01 | BUWO | 1110 | Wetland | Baum, R. | Pond 7 |
| 114 | 07-17-01 | BUWO | 1110 | Wetland | Baum, R. | Pond 7 |
| 115 | 07-17-01 | BUWO | 1117 | Wetland | Baum, R. | Pond 7 |
| 116 | 07-17-01 | BUWO | 1117 | Wetland | Baum, R. | Pond 7 |
| 117 | 07-17-01 | BUWO | 1138 | Wetland | Baum, R. | Pond 7 |
| 118 | 07-17-01 | BUWO | 1138 | Wetland | Baum, R. | Pond 7 |
| 119 | 07-17-01 | BUWO | 1138 | Wetland | Baum, R. | Pond 7 |
| 120 | 07-17-01 | BUWO | 1138 | Wetland | Baum, R. | Pond 7 |
| 121 | 07-17-01 | BUWO | 1138 | Wetland | Baum, R. | Pond 7 |
| 122 | 07-17-01 | BUWO | 1138 | Wetland | Baum, R. | Pond 7 |
| 123 | 07-17-01 | BUWO | 1253 | Wetland | Baum, R. | Pond 9 |
| 124 | 07-17-01 | RAPI | 1602 | Wetland | Baum, R. | Pond 5 |
| 125 | 07-17-01 | RAPI | 1026 | Wetland | Baum, R. | Pond 6 1/2 |
| 126 | 07-17-01 | RAPI | 1037 | Wetland | Baum, R. | Pond 6 1/2 |
| 127 | 07-17-01 | RAPI | 1043 | Wetland | Baum, R. | Pond 6 1/2 |
| 128 | 07-17-01 | RAPI | 1043 | Wetland | Baum, R. | Pond 6 1/2 |
| 129 | 07-17-01 | RAPI | 1043 | Wetland | Baum, R. | Pond 6 1/2 |
| 130 | 07-17-01 | RAPI | 1043 | Wetland | Baum, R. | Pond 6 1/2 |
| 131 | 07-17-01 | RAPI | 1050 | Wetland | Baum, R. | Pond 6 1/2 |
| 132 | 07-17-01 | RAPI | 1115 | Wetland | Baum, R. | Pond 7 |
| 133 | 07-17-01 | RAPI | 1115 | Wetland | Baum, R. | Pond 7 |
| 134 | 07-17-01 | RAPI | 1115 | Wetland | Baum, R. | Pond 7 |
| 135 | 07-17-01 | RAPI | 1115 | Wetland | Baum, R. | Pond 7 |
| 136 | 07-17-01 | RAPI | 1118 | Wetland | Baum, R. | Pond 7 |
| 137 | 07-17-01 | RAPI | 1118 | Wetland | Baum, R. | Pond 7 |
| 138 | 07-17-01 | RAPI | 1118 | Wetland | Baum, R. | Pond 7 |
| 139 | 07-17-01 | RAPI | 1132 | Wetland | Baum, R. | Pond 7 |
| 140 | 07-17-01 | RAPI | 1132 | Wetland | Baum, R. | Pond 7 |
| 141 | 07-17-01 | RAPI | 1132 | Wetland | Baum, R. | Pond 7 |
| 142 | 07-17-01 | RAPI | 1132 | Wetland | Baum, R. | Pond 7 |
| 143 | 07-17-01 | RAPI | 1132 | Wetland | Baum, R. | Pond 7 |
| 144 | 07-17-01 | RAPI | 1132 | Wetland | Baum, R. | Pond 7 |
| 145 | 07-17-01 | RAPI | 0921 | Wetland | Baum, R. | Pond 8 |
| 146 | 07-17-01 | RAPI | 0921 | Wetland | Baum, R. | Pond 8 |
| 147 | 07-17-01 | RAPI | 0921 | Wetland | Baum, R. | Pond 8 |
| 148 | 07-17-01 | RAPI | 0921 | Wetland | Baum, R. | Pond 8 |
| 149 | 07-17-01 | RAPI | 0921 | Wetland | Baum, R. | Pond 8 |

| | Comments | CC | Rad | Wind | Temp | UTM zone | Easting | Northing | Elev (m) | Accuracy (m) | State | County | Survey Method |
|-----|---|-----|-------|-------|--------|----------|---------|----------|----------|--------------|-------|---------|---------------|
| 100 | juv., no capture, SW end of main pond | 5% | clear | calm | 23.8 C | 12N | 0719936 | 4973184 | 1115 | +/- 10 | WY | Bighorn | VES |
| 101 | juv., no capture, SW end of main pond | 5% | clear | calm | 23.8 C | 12N | 0719881 | 4973187 | 1117 | +/- 10 | WY | Bighorn | VES |
| 102 | juv., no capture, SW end of main pond | 5% | clear | calm | 23.8 C | 12N | 0719861 | 4973196 | 1118 | +/- 10 | WY | Bighorn | VES |
| 103 | juv., no capture, SW end of main pond | 5% | clear | calm | 23.8 C | 12N | 0719811 | 4973194 | 1118 | +/- 10 | WY | Bighorn | VES |
| 104 | juv., no capture, SW end of main pond | 5% | clear | calm | 23.8 C | 12N | 0719811 | 4973194 | 1118 | +/- 10 | WY | Bighorn | VES |
| 105 | juv., no capture, SW end of main pond | 5% | clear | calm | 23.8 C | 12N | 0719811 | 4973194 | 1118 | +/- 10 | WY | Bighorn | VES |
| 106 | juv., no capture, SW end of main pond | 5% | clear | calm | 23.8 C | 12N | 0720131 | 4973109 | 1114 | +/- 10 | WY | Bighorn | VES |
| 107 | juv., no capture, SW end of main pond | 5% | clear | calm | 23.8 C | 12N | 0720131 | 4973109 | 1114 | +/- 10 | WY | Bighorn | VES |
| 108 | juv., no capture, SW end of main pond | 5% | clear | calm | 23.8 C | 12N | 0720131 | 4973109 | 1114 | +/- 10 | WY | Bighorn | VES |
| 109 | juv. (1.8 cm SVL), shallow water w/ grass hummocks, dp | 30% | clear | calm | 31.8 C | 12N | 0716299 | 4973371 | 1142 | +/- 10 | WY | Bighorn | VES |
| 110 | juv. (2 cm SVL), muddy edge on north end | 10% | clear | light | 25.4 C | 12N | 0721776 | 4967945 | 1117 | +/- 10 | WY | Bighorn | VES |
| 111 | juv., muddy edge on north end | 10% | clear | light | 25.4 C | 12N | 0721776 | 4967945 | 1117 | +/- 10 | WY | Bighorn | VES |
| 112 | juv., muddy edge on north end | 10% | clear | light | 25.4 C | 12N | 0721776 | 4967945 | 1117 | +/- 10 | WY | Bighorn | VES |
| 113 | juv. (2.4 cm SVL), muddy shoreline at NW end, dp | 10% | clear | light | 25.4 C | 12N | 0721805 | 4967643 | 1121 | +/- 10 | WY | Bighorn | VES |
| 114 | juv., muddy shoreline at NW end, dp | 10% | clear | light | 25.4 C | 12N | 0721805 | 4967643 | 1121 | +/- 10 | WY | Bighorn | VES |
| 115 | juv., NW end in shallows along muddy shore, dp | 10% | clear | light | 25.4 C | 12N | 0721806 | 4967638 | 1122 | +/- 10 | WY | Bighorn | VES |
| 116 | juv., NW end in shallows along muddy shore, dp | 10% | clear | light | 25.4 C | 12N | 0721806 | 4967638 | 1122 | +/- 10 | WY | Bighorn | VES |
| 117 | juv. (2.7 cm SVL), NW end in shallows along muddy edge, dp | 10% | clear | light | 25.4 C | 12N | 0721843 | 4967527 | 1115 | +/- 10 | WY | Bighorn | VES |
| 118 | juv., NW end in shallows along muddy edge, dp | 10% | clear | light | 25.4 C | 12N | 0721843 | 4967527 | 1115 | +/- 10 | WY | Bighorn | VES |
| 119 | juv., NW end in shallows along muddy edge, dp | 10% | clear | light | 25.4 C | 12N | 0721843 | 4967527 | 1115 | +/- 10 | WY | Bighorn | VES |
| 120 | juv., NW end in shallows along muddy edge, dp | 10% | clear | light | 25.4 C | 12N | 0721843 | 4967527 | 1115 | +/- 10 | WY | Bighorn | VES |
| 121 | juv., NW end in shallows along muddy edge, dp | 10% | clear | light | 25.4 C | 12N | 0721843 | 4967527 | 1115 | +/- 10 | WY | Bighorn | VES |
| 122 | juv., NW end in shallows along muddy edge, dp | 10% | clear | light | 25.4 C | 12N | 0721843 | 4967527 | 1115 | +/- 10 | WY | Bighorn | VES |
| 123 | juv. (2.2 cm SVL), open water near muddy edge, dp | 20% | clear | calm | 30.2 C | 12N | 0722341 | 4966977 | 1122 | +/- 10 | WY | Bighorn | VES |
| 124 | adult (7.4 cm SVL), water at edge of cattails, dp | 30% | clear | calm | 31.8 C | 12N | 0716380 | 4973658 | 1141 | +/- 10 | WY | Bighorn | VES |
| 125 | juv. (4.3 cm SVL), west end of pond in emergents, dp | 10% | clear | light | 25.4 C | 12N | 0721907 | 4967722 | 1117 | +/- 10 | WY | Bighorn | VES |
| 126 | juv., unable to capture | 10% | clear | light | 25.4 C | 12N | 0721781 | 4967897 | 1121 | +/- 10 | WY | Bighorn | VES |
| 127 | juv. (4.9 cm SVL), at muddy edge next to rushes, w side, dp | 10% | clear | light | 25.4 C | 12N | 0721776 | 4967922 | 1116 | +/- 10 | WY | Bighorn | VES |
| 128 | juv., at muddy edge next to rushes, west side, dp | 10% | clear | light | 25.4 C | 12N | 0721776 | 4967922 | 1116 | +/- 10 | WY | Bighorn | VES |
| 129 | juv., at muddy edge next to rushes, west side, dp | 10% | clear | light | 25.4 C | 12N | 0721776 | 4967922 | 1116 | +/- 10 | WY | Bighorn | VES |
| 130 | juv., at muddy edge next to rushes, west side, dp | 10% | clear | light | 25.4 C | 12N | 0721776 | 4967922 | 1116 | +/- 10 | WY | Bighorn | VES |
| 131 | juv. (4.7 cm SVL) at muddy edge, dp | 10% | clear | light | 25.4 C | 12N | 0721777 | 4967949 | 1120 | +/- 10 | WY | Bighorn | VES |
| 132 | juv., NW end in shallows, dp | 10% | clear | light | 25.4 C | 12N | 0721806 | 4967650 | 1122 | +/- 10 | WY | Bighorn | VES |
| 133 | juv., NW end in shallows, dp | 10% | clear | light | 25.4 C | 12N | 0721806 | 4967650 | 1122 | +/- 10 | WY | Bighorn | VES |
| 134 | juv., NW end in shallows, dp | 10% | clear | light | 25.4 C | 12N | 0721806 | 4967650 | 1122 | +/- 10 | WY | Bighorn | VES |
| 135 | Adult, NW end shallows near grass hummocks, dp | 10% | clear | light | 25.4 C | 12N | 0721806 | 4967650 | 1122 | +/- 10 | WY | Bighorn | VES |
| 136 | juv., NW end in shallows near grass hummocks, dp | 10% | clear | light | 25.4 C | 12N | 0721806 | 4967645 | 1122 | +/- 10 | WY | Bighorn | VES |
| 137 | juv., NW end in shallows near grass hummocks, dp | 10% | clear | light | 25.4 C | 12N | 0721806 | 4967645 | 1122 | +/- 10 | WY | Bighorn | VES |
| 138 | juv., NW end in shallows near grass hummocks, dp | 10% | clear | light | 25.4 C | 12N | 0721806 | 4967645 | 1122 | +/- 10 | WY | Bighorn | VES |
| 139 | juv., NW end in shallows near grass hummocks, dp | 10% | clear | light | 25.4 C | 12N | 0721820 | 4967567 | 1123 | +/- 10 | WY | Bighorn | VES |
| 140 | juv., NW end in shallows near grass hummocks, dp | 10% | clear | light | 25.4 C | 12N | 0721820 | 4967567 | 1123 | +/- 10 | WY | Bighorn | VES |
| 141 | juv., NW end in shallows near grass hummocks, dp | 10% | clear | light | 25.4 C | 12N | 0721820 | 4967567 | 1123 | +/- 10 | WY | Bighorn | VES |
| 142 | juv., NW end in shallows near grass hummocks, dp | 10% | clear | light | 25.4 C | 12N | 0721820 | 4967567 | 1123 | +/- 10 | WY | Bighorn | VES |
| 143 | juv., NW end in shallows near grass hummocks, dp | 10% | clear | light | 25.4 C | 12N | 0721820 | 4967567 | 1123 | +/- 10 | WY | Bighorn | VES |
| 144 | juv., NW end in shallows near grass hummocks, dp | 10% | clear | light | 25.4 C | 12N | 0721820 | 4967567 | 1123 | +/- 10 | WY | Bighorn | VES |
| 145 | juv. (4.5 cm SVL), SW end along muddy shore, dp | 10% | clear | light | 19 C | 12N | 0722084 | 4967607 | 1118 | +/- 10 | WY | Bighorn | VES |
| 146 | juv., SW end along muddy shore w/ emergents, dp | 10% | clear | light | 19 C | 12N | 0722084 | 4967607 | 1118 | +/- 10 | WY | Bighorn | VES |
| 147 | juv., SW end along muddy shore w/ emergents, dp | 10% | clear | light | 19 C | 12N | 0722084 | 4967607 | 1118 | +/- 10 | WY | Bighorn | VES |
| 148 | juv., SW end along muddy shore w/ emergents, dp | 10% | clear | light | 19 C | 12N | 0722084 | 4967607 | 1118 | +/- 10 | WY | Bighorn | VES |
| 149 | juv., SW end along muddy shore w/ emergents, dp | 10% | clear | light | 19 C | 12N | 0722084 | 4967607 | 1118 | +/- 10 | WY | Bighorn | VES |

| | Date | Species | Time | Habitat | Observer(s) | Location |
|-----|----------|---------|------|---------------------------|------------------|--|
| 150 | 07-17-01 | RAPI | 0921 | Wetland | Baum, R. | Pond 8 |
| 151 | 07-17-01 | RAPI | 0921 | Wetland | Baum, R. | Pond 8 |
| 152 | 07-17-01 | RAPI | 0938 | Wetland | Baum, R. | Pond 8 |
| 153 | 07-17-01 | RAPI | 0945 | Wetland | Baum, R. | Pond 8 |
| 154 | 07-17-01 | RAPI | 0945 | Wetland | Baum, R. | Pond 8 |
| 155 | 07-17-01 | RAPI | 0945 | Wetland | Baum, R. | Pond 8 |
| 156 | 07-17-01 | RAPI | 0945 | Wetland | Baum, R. | Pond 8 |
| 157 | 07-17-01 | RAPI | 0953 | Wetland | Baum, R. | Pond 8 |
| 158 | 07-17-01 | RAPI | 1218 | Wetland | Baum, R. | Pond 9 |
| 159 | 07-17-01 | RAPI | 1235 | Wetland | Baum, R. | Pond 9 |
| 160 | 07-17-01 | RAPI | 1300 | Wetland | Baum, R. | Pond 9 |
| 161 | 07-17-01 | THEL | 0918 | Wetland | Baum, R. | Pond 7 |
| 162 | 07-17-01 | THEL | 1246 | Wetland | Baum, R. | Pond 9 |
| 163 | 07-18-01 | THEL | 0807 | Wetland | Baum, R. | Leck Mayes Pond |
| 164 | 08-06-01 | CRVI | N/A | Desert shrubland | Grams, K. (USGS) | Hwy 37 |
| 165 | 08-06-01 | CRVI | N/A | Desert shrubland | Park personnel | Intersection of Hwy 37 and Horseshoe Bend road |
| 166 | 08-06-01 | CRVI | N/A | Juniper/Mountain mahogany | Grams, K. (USGS) | south of Devil Canyon Overlook |
| 167 | 08-10-01 | CHBO | N/A | Riparian vegetation | Grams, K. (USGS) | Five Springs (West side of Bighorn Mtns.) |
| 168 | 08-10-01 | SCGR | 1608 | Juniper/Mountain mahogany | Baum, R. | ~5 miles north of Crooked Cr. on West side of road |
| 169 | 08-10-01 | SCGR | 1621 | Juniper/Mountain mahogany | Baum, R. | ~5 miles north of Crooked Cr. on West side of road |
| 170 | 08-10-01 | SCGR | 1630 | Juniper/Mountain mahogany | Baum, R. | ~5 miles north of Crooked Cr. on West side of road |
| 171 | 08-10-01 | SCGR | 1641 | Juniper/Mountain mahogany | Baum, R. | ~5 miles north of Crooked Cr. on West side of road |
| 172 | 08-10-01 | SCGR | 1042 | Juniper/Mountain mahogany | Baum, R. | near T3 |
| 173 | 08-10-01 | THEL | 1219 | Riparian vegetation | Baum, R. | Hillsboro area, near T6 |
| 174 | 08-11-01 | CRVI | N/A | Disturbed/Barren | Park personnel | Ewing Snell Ranch |
| 175 | 08-11-01 | SCGR | 1348 | Juniper/Mountain mahogany | Baum, R. | State line trail |
| 176 | 08-11-01 | SCGR | 1411 | Juniper/Mountain mahogany | Baum, R. | State line trail |
| 177 | 08-11-01 | SCGR | 1450 | Juniper/Mountain mahogany | Baum, R. | State line trail |
| 178 | 08-11-01 | THEL | N/A | Disturbed/Barren | Park personnel | Barrys Landing parking lot |
| 179 | 08-11-01 | THEL | 1007 | Disturbed/Barren | Baum, R. | Near cabin at Ewing-Snell ranch |
| 180 | 08-13-01 | CRVI | 0800 | Desert shrubland | Baum, R. | T1 |
| 181 | 08-13-01 | CRVI | 0850 | Riparian vegetation | Baum, R. | T4 |
| 182 | 08-13-01 | SCGR | 0800 | Desert shrubland | Baum, R. | T1 |
| 183 | 08-13-01 | SCGR | 0940 | Disturbed/Barren | Baum, R. | T6A |

| | Comments | CC | Rad | Wind | Temp | UTM zone | Easting | Northing | Elev (m) | Accuracy (m) | State | County | Survey Method |
|-----|---|-----|-------|-------|--------|----------|---------|----------|----------|--------------|-------|---------|---------------|
| 150 | juv., SW end along muddy shore w/ emergents, dp | 10% | clear | light | 19 C | 12N | 0722084 | 4967607 | 1118 | +/- 10 | WY | Bighorn | VES |
| 151 | juv., SW end along muddy shore w/ emergents, dp | 10% | clear | light | 19 C | 12N | 0722084 | 4967607 | 1118 | +/- 10 | WY | Bighorn | VES |
| 152 | juv., S end along muddy shore w/ emergents | 10% | clear | light | 19 C | 12N | 0722137 | 4967642 | 1117 | +/- 10 | WY | Bighorn | VES |
| 153 | juv. (4.6 cm SVL), muddy edge at south end, dp | 10% | clear | light | 19 C | 12N | 0722189 | 4967640 | 1121 | +/- 10 | WY | Bighorn | VES |
| 154 | juv., no capture, muddy edge at south end, dp | 10% | clear | light | 19 C | 12N | 0722189 | 4967640 | 1121 | +/- 10 | WY | Bighorn | VES |
| 155 | juv., no capture, muddy edge at south end, dp | 10% | clear | light | 19 C | 12N | 0722189 | 4967640 | 1121 | +/- 10 | WY | Bighorn | VES |
| 156 | juv., no capture, muddy edge at south end, dp | 10% | clear | light | 19 C | 12N | 0722189 | 4967640 | 1121 | +/- 10 | WY | Bighorn | VES |
| 157 | juv., no capture, iat edge of tall rushes, dp | 10% | clear | light | 19 C | 12N | 0722456 | 4967717 | 1121 | +/- 10 | WY | Bighorn | VES |
| 158 | juv. (5 cm SVL), pond edge near cattails/grass at NW end, d | 20% | clear | calm | 30.2 C | 12N | 0722271 | 4967140 | 1113 | +/- 10 | WY | Bighorn | VES |
| 159 | juv., pond edge at west end, unable to capture, dp | 20% | clear | calm | 30.2 C | 12N | 0722282 | 4967017 | 1119 | +/- 10 | WY | Bighorn | VES |
| 160 | juv. (3.7 cm SVL), water at pond edge near grass, dp | 20% | clear | calm | 30.2 C | 12N | 0722345 | 4966975 | 1116 | +/- 10 | WY | Bighorn | VES |
| 161 | NW end | 10% | clear | light | 19 C | 12N | 0721847 | 4967692 | 1120 | +/- 10 | WY | Bighorn | VES |
| 162 | adult, SW end at pond edge into tall grass, unable to capture | 20% | clear | calm | 30.2 C | 12N | 0722338 | 4966992 | 1115 | +/- 10 | WY | Bighorn | VES |
| 163 | unable to capture, road alongside canal in tall grass | 50% | clear | calm | 20.6 C | 12N | 0716873 | 4970962 | 1136 | +/- 10 | WY | Bighorn | VES |
| 164 | on road at park entrance | | | | n/a | 12N | 0714227 | 4982079 | n/a | +/- 30 | WY | Bighorn | Contr obs |
| 165 | waypoint taken with gps | | | | n/a | 12N | 0713863 | 4981989 | n/a | +/- 10 | WY | Bighorn | Contr obs |
| 166 | | | | | n/a | 12N | 0716093 | 4988445 | n/a | +/- 30 | MT | Carbon | Contr obs |
| 167 | observed at spring in rocky area | | | | n/a | 12N | n/a | n/a | n/a | +/- 30 | WY | Bighorn | Contr obs |
| 168 | | 10% | clear | calm | 30.8 C | 12N | 0715194 | 4987289 | 1351 | +/- 10 | MT | Carbon | VES |
| 169 | | 10% | clear | calm | 30.8 C | 12N | 0714995 | 4987073 | 1365 | +/- 10 | MT | Carbon | VES |
| 170 | | 10% | clear | calm | 30.8 C | 12N | 0714796 | 4986973 | 1280 | +/- 10 | MT | Carbon | VES |
| 171 | | 10% | clear | calm | 30.8 C | 12N | 0714703 | 4986903 | 1241 | +/- 10 | MT | Carbon | VES |
| 172 | | | | | n/a | 12N | 0715022 | 4989075 | 1397 | +/- 10 | MT | Carbon | Opp obs |
| 173 | no capture | | | | n/a | 12N | 0717454 | 4997658 | 1175 | +/- 10 | MT | Carbon | Opp obs |
| 174 | next to storage shed behind cabin | | | | n/a | 12N | 0715358 | 4995747 | n/a | +/- 10 | WY | Bighorn | Contr obs |
| 175 | | 25% | clear | calm | 31.8 C | 12N | 0715641 | 4986747 | 1339 | +/- 10 | MT | Carbon | VES |
| 176 | | 25% | clear | calm | 31.8 C | 12N | 0716270 | 4986651 | 1366 | +/- 10 | MT | Carbon | VES |
| 177 | | 25% | clear | calm | 31.8 C | 12N | 0716208 | 4986651 | 1328 | +/- 10 | MT | Carbon | VES |
| 178 | | | | | n/a | 12N | 0719505 | 4997387 | n/a | +/- 30 | MT | Carbon | Contr obs |
| 179 | in grass lawn next to house | | | | n/a | 12N | 0715388 | 4995730 | 1317 | +/- 10 | MT | Carbon | Opp obs |
| 180 | | | | | n/a | 12N | 0713572 | 4980908 | 1165 | +/- 10 | WY | Bighorn | Trap cap |
| 181 | Ewing-Snell area, next to Layout Cr. | | | | n/a | 12N | 0715334 | 4995788 | 1329 | +/- 10 | MT | Carbon | Trap cap |
| 182 | male | | | | n/a | 12N | 0713572 | 4980908 | 1165 | +/- 10 | WY | Bighorn | Trap cap |
| 183 | Hillsboro | | | | n/a | 12N | 0717410 | 4997658 | 1208 | +/- 10 | MT | Carbon | Trap cap |

Appendix C

Wetland and Upland Sampling Site Photos



Photo of Pond 8 looking east towards the Bighorn Mountains (Kane Quadrangle, Wyo. 7.5 minute series).



Pond 8 looking west (Kane Quadrangle, Wyo. 7.5 minute series).



View of Leck Mays pond looking west (Kane Quadrangle, Wyo. 7.5 minute series).



Photo taken of railroad pond from the southeast end looking north (Kane Quadrangle, Wyo. 7.5 minute series).



Photo of pond 5 from the south end looking north (Sykes Spring Quadrangle, Wyo. 7.5 minute series).



Photo taken from the northeast end of classroom pond looking south (Lovell Lakes Quadrangle, Wyo. 7.5 minute series).



View of Pond 6 from the southeast end looking northwest (Natural Trap Cave Quadrangle, Wyo. 7.5 minute series).



The north end of Pond 6 looking southwest (Natural Trap Cave Quadrangle, Wyo. 7.5 minute series).



The west side of Pond 7 looking north (Kane Quadrangle, Wyo. 7.5 minute series).



Looking east over pond located next to the south side of Kane Cemetery Pond (Natural Trap Cave Quadrangle, Wyo. 7.5 minute series).



Pond 6 ½ looking east (Kane Quadrangle, Wyo. 7.5 minute series).



The northwest end of Pond 9 looking south (Kane Quadrangle, Wyo. 7.5 minute series).



This photo looking west over pond 11 was taken on May 23, 2001. The pond was completely dry in early June (Kane Quadrangle, Wyo. 7.5 minute series).



Photo taken on May 29, 2001 of ponds 1 and 2 looking north. These ponds were completely dry and not included in our surveys (Lovell Lakes Quadrangle, Wyo. 7.5 minute series).



The east side of pond 4 looking west (Lovell Lakes Quadrangle, Wyo. 7.5 minute series).



Photo taken from the northeast end of pond 3 looking south (Lovell Lakes Quadrangle, Wyo. 7.5 minute series).



Upland area near Horseshoe Bend campground consisting of basin grassland and juniper habitat. This photo was taken looking south toward Horseshoe Bend during a visual encounter survey (Sykes Spring Quadrangle, Wyo. 7.5 minute series).



Riparian woodland habitat at Hillsboro looking west toward the Pryor Mountains This area was searched using visual encounter surveys (Hillsboro Quadrangle, Mont. 7.5 minute series).



Creek woodland area searched using visual encounter surveys located south of Mason-Lovell Ranch (Kane Quadrangle, Wyo. 7.5 minute series).



Desert shrubland habitat searched near Sykes Mountain using visual encounter surveys (Sykes Spring Quadrangle, Wyo. 7.5 minute series).



Photo of desert shrubland habitat located southwest of Sykes Mountain (Sykes Spring Quadrangle, Wyo. 7.5 series).



Desert shrubland habitat located south of Sykes Mountain (Sykes Spring Quadrangle, Wyo. 7.5 minute series).



Photo of terrestrial funnel traps at trap site 1 (UTM 12N e0713572 n4980904) in desert shrubland habitat. This photo was taken looking east toward Sykes Mtn. (Sykes Springs Quadrangle, Wyo. 7.5 minute series).



Photo of riparian habitat at Crooked Creek that was searched using visual encounter surveys (Sykes Spring Quadrangle, Wyo. 7.5 minute series).



View of mixed desert shrubland habitat near Horseshoe Bend looking north (Sykes Spring Quadrangle, Wyo. 7.5 minute series).



View of juniper/mountain mahogany habitat north of Horseshoe Bend (Sykes Spring Quadrangle, Wyo. 7.5 minute series).



Photo of mountain mahogany habitat taken northeast of Horseshoe Bend (Mystery Cave Qudarangle, Mont.-Wyo. 7.5 minute series).



Photo of sagebrush steppe habitat located north of Layout Creek and the Ewing-Snell Ranch (Hillsboro Quadrangle, Mont.-Wyo. 7.5 minute series).



Voucher photo of a Northern Leopard Frog (*Rana pipiens*).